

Mites of the Subfamily Laelaptinae in Panama (Acarina: Laelaptidae)

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During the past few years we have collected several hundred small mammals in Panama. The ectoparasites removed from these animals form a most interesting collection, of which the Acarina are by far the most numerous. The present study is limited to mites of the subfamily Laelaptinae, since the vast majority of the mesostigmatid mites collected belong to eight genera of this subfamily. Of these, *Laelaps* Koch, *Gigantolaelaps* Fonseca, *Eubrachylaelaps* Ewing, *Echinolaelaps* Ewing and *Mysolaelaps* Fonseca, are most commonly associated with myomorph rodents; *Tur* Baker and Wharton with hystricomorph rodents; *Steptolaelaps* Furman with sciuromorph rodents, and *Haemolaelaps* Berlese with both rodents and marsupials.

As Furman and Tipton (1961) point out, "The study of neotropical parasitic mites is of importance because they may fill key roles in epidemiological patterns which for the moment are confusing." Because they are numerous and widespread, it is possible that mites may figure prominently in the solution of some of our more perplexing epidemiological problems in the tropics.

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America. We are especially indebted to Dr. Deane P. Furman, University of California at Berkeley, as our format and some of our keys essentially follow those of Furman and Tipton (1961).

KEY TO THE PANAMANIAN GENERA OF LAELAPTINAE
FEMALES; FROM FURMAN AND TIPTON, 1961

1. Genito-ventral plate with one pair of setae2
Genito-ventral plate with more than one pair of setae4
2. Peritremalia produced posterior to stigmata; posterior seta of coxa II similar to setae of other coxae3
Peritremalia not produced posterior to stigmata; posterior seta of coxa II longer than setae of other coxae*Gigantolaelaps* Fonseca
3. Spine-like seta on posterior margin of coxa III; elongate setae on dorsal apices of femur and genu I; tectum with three apical lobes*Eubrachylaelaps* Ewing
Coxa III without spine-like seta; femur and genu I without elongate setae; tectum a single rounded lobe*Haemolaelaps* Berlese
4. Genito-ventral plate with three pairs of setae*Steptolaelaps* Furman
Genito-ventral plate with four pairs of setae5
5. Central setae of dorsal plate minute; coxae without spiniform setae
.....*Mysolaelaps* Fonseca
Central setae of dorsal plate not minute; at least one pair of coxae with spiniform setae6
6. Large mites, over 1 mm. long; sternal plate as long or longer than wide
.....*Echinolaelaps* Ewing
Medium sized mites, less than 1 mm. long; sternal plate never as long as wide7
7. Peritremal plate broad; epigynial and anal plates fused or in juxtaposition
.....*Tur* Baker and Wharton
Peritremal plate narrow; epigynial and anal plates not fused or in juxtaposition
.....*Laelaps* Koch

We prefer to summarize the morphological characteristics of the genera in a tabular form (table 1) rather than treat each genus separately, since Tipton (1960) and Furman and Tipton (1961) have recently discussed this group of genera.

Some of the characters listed in table 1 are variable in occurrence in certain genera. Thus, coarse dorsal setae occur consistently in species of *Echinolaelaps*, *Steptolaelaps* and *Tur*, but only in some species of *Eubrachylaelaps*, *Gigantolaelaps* and *Laelaps*. There are numerous setae on the unarmed portion of the venter in some species of *Haemolaelaps* but not in others. The value of the tectum as a generic character has not been fully investigated. In *Tur anomalus* n. sp., the tectum is very difficult to see, but appears to be a single lobe; it is trilobed in *T. uniscutatus*.

Genus *Echinolaelaps* Ewing

Macrolaelaps Ewing, 1929, Man. Ext. Parasites, p. 185.

Echinolaelaps Ewing, 1929, loc. cit., pp. 185-186.

Type-species: *Laelaps echidninus* Berlese, 1887.

This genus is represented in Panama by two species, one of them (*E. lowei* n. sp.) known only from Panama.

Echinolaelaps echidninus (Berlese)

Laelaps echidninus Berlese, 1887, Acari, Myriap. Scorp. Italia, pt. 39, p. 157.

Echinolaelaps echidninus Ewing, 1929, Man. Ext. Parasites, p. 185.

MATERIAL EXAMINED: 9 females from *Rattus rattus*, Arraiján (Panama), 5 April 1961, collected by C. M. Keenan and V. J. Tipton.

REMARKS: Our Panamanian material differs very little from specimens in our collections from other parts of the world. We have collected hundreds of specimens of both *R. rattus* and *R. norvegicus* but have found only a single rat infested with *E. echidninus*. However, *Laelaps nuttalli* was very abundant.

TABLE 1. COMPARATIVE CHART OF PANAMANIAN GENERA OF LAELAPTINAE (FEMALES)

| Character | <i>Echinolaelaps</i> | <i>Eubrachylaelaps</i> | <i>Gigantolaelaps</i> | <i>Haemolaelaps</i> | <i>Laelaps</i> | <i>Mysolaelaps</i> | <i>Steptolaelaps</i> | <i>Tur</i> |
|-------------------------------|----------------------|------------------------|-----------------------|---------------------|----------------|--------------------|----------------------|------------|
| Idiosoma over 1 mm. | + | 0 | + | 0 | 0 | + | 0 | 0 |
| Pairs of setae on G-V plate | 4 | 1 | 1 | 1 | 4 | 4 | 3 | 4 |
| Number of lobes in tectum* | 4 | 3 | 1 | 1 | 3 | 3 | 1 | 3 |
| At least 1 robust coxal seta | + | + | + | 0 | + | 0 | + | + |
| Pilosity of venter sparse | + | 0 | + | + | + | + | + | + |
| Sternal plate as long as wide | + | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dorsal setae coarse | + | 0 | 0 | 0 | + | 0 | + | + |

*Refers only to Panamanian species

Echinolaelaps lowei Tipton, new species. Plate 1.

DIAGNOSIS: Like *E. boultoni* Furman and Tipton, *E. lowei* n. sp., has epigynial and anal plates which are not in juxtaposition. *E. boultoni* has bulbous setae on coxa I; these setae are piliform to setiform in *E. lowei*.

DESCRIPTION: *Idiosoma*.—1040 μ long, 697 μ wide (width measured at level of coxae IV).

Dorsum.—Dorsal plate elliptical, with 37 pairs setae; 936 μ long, 614 μ wide; covers almost entire dorsum, leaving only narrow, postero-lateral band of soft integument bearing 14 pairs setae; posterior margin with three pairs longer than medial setae; penultimate setae about one-half length of last pair.

Venter.—Tritosternum bifurcate near base, pilose; sternal plate coarsely reticulate; 198 μ long, 161 μ wide; with three pairs setae approximately same length; one pair slit-like pores just caudad of first pair setae. Endopodal plates well defined; with setae smaller than sternal setae. Metapodal plates small, elongate. Epigynial plate expanded; with prominent transverse lines; with four pairs setae, distance between first pair 130 μ , second pair 198 μ , third pair 151 μ , fourth pair 73 μ ; anal plate widely separated from

epigynial plate; 146 μ long, 114 μ wide; distance between anterior margin of plate and anus much greater than length of anus; adanal setae 52 μ long; postanal seta 104 μ long.

Legs.—Legs long and slender except for leg II, which is more robust. Setae of coxa I piliform to setiform; a short, bulbous seta on coxa III. Dorsal apices of femur and genu I with setae less robust than sternal setae.

Gnathosoma.—Deutosternum with seven rows of two to five teeth per row. Gnathosomal setae about one-half length of medial hypostomal setae. Chelae robust, both digits toothed; fixed digit bearing long, bent seta. Hypopharyngeal processes prominent, fimbriate epipharynx sublanceolate, covered with denticles. Tectum not apparent.

TYPE MATERIAL: Holotype female from *Nectomys alfarí* (host no. 4082), Cerro Azul (Panamá), 2 February 1958, collected by R. M. Altman and C. M. Keenan. In the collection of the United States National Museum. A paratype female, same data and repository as the holotype.

REMARKS: This species is named for Mr. Wilbur Lowe, a remarkable technician and a tireless worker.

Genus *Eubrachylaelaps* Ewing

Eubrachylaelaps Ewing, 1929, Man. Ext. Parasites, p. 186. Furman, 1955a, Ann.

Ent. Soc. Amer., 48, (1-2), pp. 51-59 (revision and key).

Cyclolaelaps Ewing, 1933, Proc. U.S. Nat. Mus., 82, (30), p. 5.

Type-species: *Laelaps hollisteri* Ewing, 1925.

Only one species of this genus is recorded from Panama. It would be unusual, however, if *E. rotundus* Fonseca is not collected in Panama in the future; it occurs in nearby Venezuela.

Eubrachylaelaps jamesoni Furman. Plate 2.

Eubrachylaelaps jamesoni Furman, 1955a, Ann. Ent. Soc. Amer., 48, (1-2), pp. 52-54, figs. 1-4.

MATERIAL EXAMINED: 153 females from *Peromyscus nudipes*, Cerro Punta; 83 females from *P. nudipes* from Rancho Mojica; 2 females from *Oryzomys fulvescens*, Cerro Punta and Rancho Mojica; 1 female from *Reithrodontomys creper*; 1 female from *Heteromys desmarestianus*, Cerro Punta; and hundreds of specimens in alcohol from both localities, mostly from *P. nudipes*; January 1960 to March 1962, collected by C. O. Handley, C. M. Keenan, V. J. Tipton, and C. E. Yunker.

REMARKS: Our measurements of the dorsal and sternal plates of Panama specimens are roughly comparable to those given by Furman (1955a) for type material from Mexico. Specimens from Rancho Mojica are slightly smaller (average length of dorsal plate for 10 specimens, 590 μ), less heavily sclerotized with the setae of the venter apparently a little more delicate than specimens from Cerro Punta (average length of dorsal plate for 10 specimens, 626 μ). The average ratio of length to width of sternal plate is 2 to 1 for Rancho Mojica specimens and 2.1 to 1 for Cerro Punta specimens.

We must add that different mounting techniques were used for specimens from these two localities. Additional recently collected specimens from Cerro Punta were treated in much the same manner (using heat as a part of the mounting technique) as the Rancho Mojica specimens and the morphological differences were then not nearly as apparent.

Genus *Gigantolaelaps* Fonseca

Gigantolaelaps Fonseca, 1939a, Mem. Inst. Butantan, 12: 12 (transl., p. 61).

Type-species: *Gigantolaelaps vitzthumi* Fonseca, 1939.

The genus *Gigantolaelaps* Fonseca is well represented in Panama, both by species and individuals. We have tentatively associated our Panamanian specimens with five described species.

KEY TO THE PANAMANIAN SPECIES OF *GIGANTOLAE LAP S*

FEMALES

1. Sternal plate with two to six (usually three) accessory setae
.....*G. oudemansi* Fonseca
Sternal plate with no accessory setae2
2. Proximal seta of coxa I longer than distal seta; both setae spiniform
.....*G. goyanensis* Fonseca
Proximal seta of coxa I not longer than distal seta; distal seta always piliform,
proximal seta usually piliform3
3. Dorsal plate bearing approximately 400 setae; a relatively small species with
dorsal plate not over 1100 μ long*G. inca* Fonseca
Dorsal plate bearing 86 setae; a relatively large species with dorsal plate over
1400 μ long4
4. Antero-median projection of sternal plate scarcely produced beyond insertion of
first pair of setae. Small paired setae of posterior margin of dorsal plate reach
beyond margin for not more than one-fourth of their length...*G. gilmorei* Fonseca
Antero-median projection of sternal plate produced far beyond insertion of first
pair of setae as a pronounced lobe. Small paired setae of posterior margin of
dorsal plate reach beyond margin for more than one-fourth of their length...
.....*G. wolffsohni* (Oudemans)

Gigantolaelaps gilmorei Fonseca. Plates 3 (figs. 4, 8), 4.

Gigantolaelaps gilmorei Fonseca, 1939a, Mem. Inst. Butantan, 12: 22 (transl., p. 71), figs. 6-10 (Goyaz State, Brazil). Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), pp. 175, 177, pls. 2 (fig. 9), 3 (figs. 1, 2), 4 (fig. 6), 5 (fig. 2), 6 (fig. 2).

MATERIAL EXAMINED: A total of 206 females and 1 male as follows: 179 females and 1 male from (35) *Oryzomys capito*; 27 females from (5) *O. alfaroi*; 13 females from (2) *O. bombycinus*; 3 females from (1) *O. caliginosus*; 4 females from (1) *Nectomys alfari*; 3 females from (1) *Sigmodon hispidus*; 1 female from (1) *Reithrodontomys sumichrasti*; 1 female from (1) *Zygodontomys microtinus*; 1 female from (1) *Proechimys semispinosus*.

Most specimens from *O. capito* and *O. alfaroi* were collected at Cerro Hoya (Los Santos) by C. O. Handley, February 1962. Most others were collected at Cerro Azul (Panamá) and Canal Zone, July 1956 to January 1962, by Robert M. Altman, C. M. Keenan and V. J. Tipton.

REMARKS: *G. gilmorei* Fonseca is a large species (idiosoma well over 2000 μ in length), distinct from others of the genus in possessing the following combination of characters: the bases of the first pair of sternal setae are on or very near the anterior margin of the sternal plate; both setae of coxa I are piliform; and the epigynial setae do not extend to the caudal margin of the epigynial plate.

The majority of our specimens were collected from a group of closely related species of the genus *Oryzomys* at localities of 2000-3000 feet elevation. They conform rather closely to the description and figures given by Fonseca (1939a) except that the epigynial setae are shorter, the setae of the venter are somewhat more sparse, and the anal and epigynial setae slightly more delicate than indicated by Fonseca.

***Gigantolaelaps goyanensis* Fonseca.** Plates 3 (figs. 1, 6), 5.

Gigantolaelaps goyanensis Fonseca, 1939a, Mem. Inst. Butantan, 12: 32 (transl., p. 81), figs. 15-18 (Brazil). Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), p. 177, pls. 3 (fig. 3), 4 (fig. 5), 5 (fig. 8), 6 (fig. 3).

MATERIAL EXAMINED: 22 females and 2 males from (1) *Zygodontomys microtinus*, Cerro Azul (Panamá), 16 August 1956, collected by R. M. Altman and C. M. Keenan.

REMARKS: *G. goyanensis* Fonseca is the only species of the genus thus far recorded from Panama in which both setae of coxa I are robust and the proximal seta is longer than the distal seta. A rather anomalous situation exists with respect to this species in that we have collected it only once although we have examined 74 specimens of *Zygodontomys microtinus*.

***Gigantolaelaps inca* Fonseca.** Plate 6.

Gigantolaelaps inca Fonseca, 1960, Acarologia, 2, (1), pp. 11-14, figs. 1, 2 (Peru). Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), pp. 182-184, pls. 2 (fig. 7), 3 (figs. 7, 8), 4 (fig. 4), 5 (fig. 7), 6 (fig. 6).

MATERIAL EXAMINED: A total of 655 females and 2 males as follows: 568 females and 2 males from (25) *Oryzomys albigularis*; 63 females from (8) *Oryzomys alfaroi*; 11 females from (1) *Peromyscus flavidus*; 9 females from (1) *Didelphis marsupialis*; 4 females from (1) *Peromyscus nudipes*; all collected above 5000 feet elevation near Cerro Punta (Chiriquí) or Rancho Mojica (Bocas del Toro) during January, February, and May, 1960, September 1961 and March 1962 by C. O. Handley, C. M. Keenan and V. J. Tipton.

REMARKS: In Panama, *G. inca* Fonseca apparently occurs only at elevations above 5000 feet. Like *G. oudemansi* Fonseca, it is a small species but it lacks the accessory setae on the sternal plate and it has very dense setae on the dorsal plate. Our specimens are not markedly different from those in our collection from Venezuela nor from figures and description given by Fonseca (1960) and Furman and Tipton (1961). The dorsal plates of our specimens appear to cover a greater area in relation to the entire specimen than do those from Venezuela and those from Peru as figured by Fonseca. However, measurements of the dorsal plates conform closely to those given by Fonseca and Furman and Tipton.

***Gigantolaelaps oudemansi* Fonseca.** Plates 3 (figs. 2, 7), 7.

Gigantolaelaps oudemansi Fonseca, 1939a, Mem. Inst. Butantan, 12: 15 (transl., p. 64), figs. 1-5 (Goyaz State, Brazil). Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), pp. 173, 175, pls. 3 (figs. 5, 6), 4 (fig. 3), 5 (fig. 6), 6 (fig. 5).

MATERIAL EXAMINED: A total of 960 females and 7 males as follows: 791 females and 6 males from (48) *Oryzomys capito*; 73 females from (6) *O. alfaroi*; 35 females from (2) *O. bombycinus*; 24 females from (2) *O. caliginosus*; 7 females from (1) *O. bicolor*; 1 female from (1) *O. fulvescens*; 22 females from (1) *Nectomys alfari*; 4 females, 1 male from (1) *Sigmodon hispidus*; 1 female from (1) *Zygodontomys microtinus*; 1 female from (1) *Peromyscus flavidus*; 1 female from (1) *Didelphis marsupialis*; from all of our collecting localities that were below 5000 feet elevation, July 1956 to February 1962, collected by R. M. Altman, C. O. Handley, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: *G. oudemansi* Fonseca is the only known species of the genus that has accessory setae on the sternal plate. We have collected *G. oudemansi* from a number of species of hosts. There are some morphological characters which vary according to host. Generally, there are three accessory setae on the sternal plate but in several specimens from *O. capito* there were four or five accessory setae. Other measurable differences are presented in table 2, based on the same criteria used by Furman and Tipton (1961). Thus, populations from different hosts and different geographic locations may be compared.

Gigantolaelaps wolffsohni (Oudemans). Plates 3 (figs. 3, 5, 9, 10), 8–11.

Laelaps wolffsohni Oudemans, 1910, Rev. Chilena Hist. Nat., 14: 147 (Chile).

Gigantolaelaps wolffsohni Morlan, 1951, Jour. Parasit., 37, (3), p. 273. Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), pp. 179–181; pls. 3 (figs. 4, 9), 4 (figs. 1, 2), 5 (figs. 1, 3–5), 6 (figs. 1, 4).

Macrolaelaps peruvianus Ewing, 1933, Proc. U. S. Nat. Mus., 82, (30), p. 7 (Lima, Peru).

Gigantolaelaps peruvianus Fonseca, 1939a, Mem. Inst. Butantan, 12: 11 (transl., p. 60).

MATERIAL EXAMINED: 140 females from hosts and localities mentioned below, collected from July 1956 to September 1961 by R. M. Altman, C. O. Handley, C. M. Keenan and V. J. Tipton.

REMARKS: Furman and Tipton (1961) have discussed the morphological variation in 75 Venezuelan specimens of *G. wolffsohni*, the majority of which were from eight identified host species. We have 140 Panamanian specimens from six host species from six localities.

Specimens taken from *Oryzomys fulvescens* at Rancho Mojica (pl. 11) are obviously quite different from those taken from *O. caliginosus* at Cerro Campana (pl. 8). On the basis of size alone they would seem to represent two distinct species, but in addition, the Cerro Campana specimens have robust setae on coxa I, and shorter penultimate setae on the dorsal plate. However, specimens from other hosts and other localities intergrade between these two extremes and in spite of vast differences in total size, the ratio between plate sizes is essentially the same in all specimens. We have tended to disregard differences in length of setae because they may be broken off or may extend at an angle through a deep focal plane, rendering measurements unreliable and bringing the factor of distortion into an already confused picture.

TABLE 2. MEASUREMENTS OF *GIGANTOLAELAPS OUDEMANSI*, BY HOST SPECIES OF *ORYZOMYS*.
(in microns)

| Character | <i>O. alfaroii</i> (6) | <i>O. bombycinus</i> (10) | <i>O. caliginosus</i> (6) | <i>O. capito</i> | | | |
|---|---------------------------|------------------------------|------------------------------|------------------|----------------|---------------------------------|---------|
| | | | | Venezuela (4) | Los Santos (7) | Canal Zone (10) Cerro Azul (10) | |
| Length of Posterior Setae of Coxae II | Range | 156-177 | 198-229 | | 200-220 | 187-208 | 187-270 |
| | Mean | 174 | 215 | | 210 | 203 | 224 |
| Length of Genito- Ventral Plate* | Range | 229-260 | 239-260 | 194-207 | 239-281 | 229-260 | 229-260 |
| | Mean | 244 | 244 | 203 | 260 | 248 | 250 |
| Distance between Genital Setae | Range | 150-160 | 140-160 | 110-121 | 146-187 | 135-156 | 125-177 |
| | Mean | 155 | 149 | 115 | 160 | 148 | 156 |
| Length of Genital Setae | Range | 177-208 | 166-198 | 169-181 | 150-208 | 166-198 | 177-208 |
| | Mean | 193 | 181 | 175 | 190 | 178 | 189 |
| Length of Accessory Setae of Sternal Plate | Range | 85-104 | 83-94 | 94-97 | 83-108 | 52-114 | 73-114 |
| | Mean | 92 | 86 | 96 | 94 | 82 | 98 |
| Length of 1st pair Sternal Setae | Range | 232-281 | 250-302 | 220-234 | 218-281 | 208-270 | 260-322 |
| | Mean | 256 | 276 | 228 | 262 | 251 | 270 |
| Distance between 1st Pair Sternal Setae | Range | 135 | 135-146 | 114-120 | 140-166 | 135-156 | 114-156 |
| | Mean | 147 | 140 | 117 | 150 | 145 | 142 |

Numbers in parentheses indicate number of specimens measured.

*Measured from level of genital setae insertions.

Our specimens fall into four groups designated A, B, C, and D. GROUP A (pl. 8), with 100 specimens from *Oryzomys caliginosus*, 2 specimens from *Nectomys alfari*, 1 specimen from *Zygodontomys microtinus*, from Cerro Azul, Cerro Campana, El Valle, and Bocas del Toro, is the largest of the four groups. The length of the dorsal plate ranges from a minimum of 1612 μ in the Bocas del Toro specimens to a maximum of 1956 μ in the Cerro Campana specimens. The length of the sternal plate ranges from a minimum of 374 μ in the Cerro Azul and Bocas del Toro specimens to a maximum of 455 μ in the Cerro Campana specimens. The setae of coxa I are more robust, the venter is more setose, and the epigynial plate is expanded somewhat more than in Group B. Group A resembles Fonseca's *G. vitzthumi*.

GROUP B (pl. 9), 12 specimens from *Oryzomys capito* and 2 specimens from *O. fulvescens* from El Valle, is characterized as follows: the length of the dorsal plate varies from 1612 to 1664 μ and the sternal plate ranges from 270 to 312 μ in length; the anterior margin of the sternal plate is not projected forward as radically as in Group A; the setae of coxa I are setiform, and the setation of the venter is somewhat more sparse than in Group A.

GROUP C (pl. 10), 12 specimens from *Sigmodon hispidus* from Bocas del Toro, differs little from the previous group except that the coxal setae are very short and somewhat spiniform. The orientation of the coxae may account for this seeming difference. Also, the venter is more setose than in Group B.

GROUP D (pl. 11), 8 specimens from *O. fulvescens* from Cerro Punta (Chiriquí) and 13 specimens from *O. fulvescens* from Rancho Mojica (Bocas del Toro), differs from the other groups in the following characters: size is small, the length of the dorsal plate varying from 1404 to 1580 μ and that of the sternal plate from 281 to 292 μ ; the setae of coxa I, especially the distal seta, are piliform; the penultimate setae of the dorsal plate extend beyond the margin of the plate for more than one-half of their length and the epigynial plate is expanded only slightly. This group appears to be Fonseca's *G. wolffsohni*, *s. str.*

We have not overlooked the possibility that these four groups may represent four distinct species, but because of the gradation in size, shown in table 3, we prefer to refer all of our specimens to one species, *G. wolffsohni*. A detailed study of specimens from its entire range will be necessary before the composition of this particular taxon is understood. However, for the moment we may say that *G. wolffsohni*, *s. lat.*, is a highly variable species which has both a wide geographical and ecological range.

Comments on the Genus *Gigantolaelaps*

Furman and Tipton (1961) have pointed out that the unusually high degree of apparent variation in *Gigantolaelaps* "may be linked in part to the evolutionary status of the host genera" as well as to a certain amount of distortion associated with the mounting technique used. We have several long series each, from single host animals. The adults in these series apparently are not all the same age; in addition, it appears that not all have fed as adults. It would be interesting and profitable to investigate the changes in total size

TABLE 3. MEASUREMENTS OF *GIGANTOLAELAPS WOLFFSOHNI* (SENSU LATO).
 (in microns)

| Character | A | | | | B | | C | | D | |
|---|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| | <i>Oryzomys caliginosus</i> | | <i>Nectomys alfari</i> | | <i>Oryzomys capito</i> | | <i>Sigmodon hispidus</i> | | <i>Oryzomys fulvescens</i> | |
| | Bocas del Toro | Cerro Azul | Cerro Campana | Cerro Azul | El Valle | Bocas del Toro | Rancho Mojica | Cerro Punta | Rancho Mojica | Cerro Punta |
| Length of Sternal Plate | Range 374-406 Mean 392 | Range 385-426 Mean 413 | Range 416-455 Mean 438 | Range 374-416 Mean 392 | Range 374-385 Mean 379 | Range 270-312 Mean 293 | Range 302-312 Mean 308 | Range 281-292 Mean 289 | Range 281-292 Mean 289 | Range 281-291 Mean 286 |
| Length of 1st pair of Sternal Setae | Range 312-385 Mean 349 | Range 364 Mean 364 | Range 374-416 Mean 392 | Range 332 Mean 332 | Range 322-343 Mean 334 | Range 281-343 Mean 312 | Range 291-332 Mean 310 | Range 302-332 Mean 315 | Range 291-332 Mean 310 | Range 302-332 Mean 315 |
| Distance between 1st pair of Sternal Setae | Range 198-228 Mean 207 | Range 185-192 Mean 190 | Range 192-210 Mean 203 | Range 160-172 Mean 166 | Range 135-161 Mean 146 | Range 148-161 Mean 158 | Range 132-145 Mean 138 | Range 135-146 Mean 142 | Range 132-145 Mean 138 | Range 135-146 Mean 142 |
| Length of Distal Seta, Coxa I | Range 88-109 Mean 101 | Range 100-114 Mean 107 | Range 109-120 Mean 113 | Range 73 Mean 73 | Range 130-146 Mean 139 | Range 52-62 Mean 55 | Range 104-125 Mean 110 | Range 104-130 Mean 120 | Range 104-125 Mean 110 | Range 104-130 Mean 120 |
| Length of Proximal Seta, Coxa I | Range 68-109 Mean 94 | Range 104 Mean 104 | Range 110-114 Mean 112 | Range 73-83 Mean 78 | Range 99-108 Mean 102 | Range 52-62 Mean 50 | Range 85-104 Mean 95 | Range 78-104 Mean 91 | Range 85-104 Mean 95 | Range 78-104 Mean 91 |
| Length of Genital Plate | Range 302-332 Mean 316 | Range 281-302 Mean 289 | Range 312-332 Mean 318 | Range 322 Mean 322 | Range 265-281 Mean 271 | Range 312-343 Mean 322 | Range 250-270 Mean 257 | Range 228-270 Mean 254 | Range 250-270 Mean 257 | Range 228-270 Mean 254 |
| Length of Genital Setae | Range 291-312 Mean 300 | Range 281-343 Mean 312 | Range 312-332 Mean 326 | Range 312 Mean 312 | Range 290-343 Mean 316 | Range 281-332 Mean 300 | Range 312-332 Mean 318 | Range 322-343 Mean 334 | Range 312-332 Mean 318 | Range 322-343 Mean 334 |
| Distance between Genital Setae | Range 239-291 Mean 272 | Range 245-275 Mean 257 | Range 265-286 Mean 280 | Range 200-250 Mean 235 | Range 224-235 Mean 228 | Range 204-239 Mean 231 | Range 200-239 Mean 216 | Range 213-225 Mean 218 | Range 200-239 Mean 216 | Range 213-225 Mean 218 |
| Length of Penultimate Setae of Dorsal Plate | Range 114-130 Mean 119 | Range 93-104 Mean 99 | Range 104-114 Mean 109 | Range 88-94 Mean 91 | Range 99-114 Mean 106 | Range 83-104 Mean 99 | Range 120-145 Mean 132 | Range 110-172 Mean 141 | Range 120-145 Mean 132 | Range 110-172 Mean 141 |
| Length of Dorsal Plate | Range 1612-1768 Mean 1695 | Range 1747-1924 Mean 1841 | Range 1820-1956 Mean 1895 | Range 1745-1820 Mean 1780 | Range 1612-1664 Mean 1624 | Range 1643-1716 Mean 1666 | Range 1404-1456 Mean 1414 | Range 1404-1580 Mean 1497 | Range 1404-1456 Mean 1414 | Range 1404-1580 Mean 1497 |

and degree of sclerotization over the life span of adult mites of this genus. It may be that plates and setae only appear to increase in size because of changes in sclerotization as a result of aging.

Genus *Haemolaelaps* Berlese

Haemolaelaps Berlese, 1910, Redia, 6: 261.

Atricholaelaps Ewing, 1929, Man. Ext. Parasites, p. 186.

Ischnolaelaps Fonseca, 1935, Mem. Inst. Butantan, 10: 19.

Type-species: *Haemolaelaps marsupialis* Berlese, 1910.

We have obtained specimens of this genus from nearly every species of rodent we have collected, as well as from several marsupials. It appears that almost all host species have a distinct population of *Haemolaelaps* and further, that each host species has distinctive populations in each collecting locality. Either host specificity is very marked, with little individual variation in a population, or else host specificity is almost entirely lacking and variation is much greater than is known for other laelaptine genera. If the latter is true, then it may be that variation is inversely proportional to host specificity.

The shape of the pilus dentilis frequently has been used as a specific character. Allred (1958) has suggested that it would be better employed to separate groups of species. This structure is delicate and is susceptible to distortion which renders it of questionable taxonomic value. We have a series in which the pilus dentilis is inflated in some specimens while in others it appears to have burst during the mounting process. In another series from *Nyctomys sumichrasti* (pl. 13), the apical as well as the proximal portion is swollen. Some of the specimens from *Metachirus nudicaudatus* are similar to those from *Nyctomys*, while others have the pilus dentilis inflated proximally only, as figured in plate 18.

Other characters too are variable within a series from a single host animal. Degree of sclerotization, length and number of setae (the latter may be due in part to orientation of the mite on the slide), and shape and size of the anal plate vary considerably. On the other hand some characters are remarkably constant, e.g., the shape of the sternal plate, the shape and length of the setae of coxa I, and the relative length of the gnathosomal and hypostomal setae.

We are referring most of our specimens to a single species, *Haemolaelaps glasgowi* (Ewing), although it is evident that there are some extreme differences among our specimens. Specimens collected from *Peromyscus nudipes* and *Reithrodontomys sumichrasti* at high elevations conform more closely to the figures and description given by Strandtmann (1949) than do those collected at low elevations. Plates 12 to 23 show the range of variation.

Haemolaelaps glasgowi (Ewing). Plates 12-23.

Laelaps glasgowi Ewing, 1925, Proc. Ent. Soc. Wash., 27: 1-7 (Illinois, U.S.A.).

Haemolaelaps glasgowi Strandtmann, 1949, Jour. Parasit., 35, (3), pp. 325-352.

MATERIAL EXAMINED: 102 females from *Peromyscus nudipes*, 41 females

from *Oryzomys fulvescens*, 19 females from *O. albigularis*, 14 females from *Reithrodontomys mexicanus*, 12 females from *R. sumichrasti*, 17 females and 1 male from *R. creper*, 1 female from *Scotinomys teguina*, and 19 females from *S. xerampelinus*, from Rancho Mojica, Cerro Punta or Boquete Trail; 49 females from *Sigmodon hispidus*, 14 females and 1 male from *Oryzomys capito*, 1 female from *O. fulvescens*, 4 females from *O. caliginosus*, 6 females from *O. alfaroi*, 1 female from *O. bombycinus*, 1 female from *Tylomys panamensis*, 11 females from *Nectomys alfari*, 4 females from *Nyctomys sumichrasti*, 3 females from *Liomys adspersus*, 4 females and 1 male from *Hoplomys gymnurus*, 7 females from *Rattus rattus*, 9 females from *Proechimys semispinosus*, 3 females from *Heteromys desmarestianus*, 2 females from *H. australis*, 2 females from *Zygodontomys microtinus*, 26 females from *Sciurus granatensis*, 47 females from *Metachirus nudicaudatus*, 8 females from *Philander opossum*, and 3 females from *Didelphis marsupialis*, mostly from Cerro Azul (Panamá) and Canal Zone.

REMARKS: Specimens from Rancho Mojica and Cerro Punta are more nearly like figures and description given by Strandtmann (1949) than those from Cerro Azul and the Canal Zone. Those from *Hoplomys gymnurus* are the largest (dorsal plate over 800 μ in length) and those from *Sigmodon hispidus* the smallest (dorsal plate 572 μ in length). The setae of the dorsal plate are robust and uniform in size in specimens from marsupials (pl. 18), while in specimens from oryzomine rodents (pl. 13), the setae of the dorsal plate are smaller and not uniform in size.

The pilosity of unarmed areas in specimens from *Nyctomys sumichrasti* (pl. 13) is sparse whereas it is much denser in specimens from *Metachirus nudicaudatus*. In considering these differences, especially the extremes in the range of variation, it seemed advisable to describe several new species. However, it was impossible to find a well delineated group of specimens that did not merge into the next group.

The genus *Haemolaelaps* is badly in need of revision. For the Neotropical Region it will be necessary to study long series from many localities in order to understand variation and geographical distribution. To describe new species now would only add confusion to a problem which becomes even more complex as additional material becomes available.

Genus *Laelaps* Koch

Laelaps Koch, 1836, Deutschl. Crust. Myriap. Arach., pt. 4, p. 19. Tipton, 1960, Univ. Calif. Publ. Ent., 16, (6), pp. 260-262 (generic revision).

Type-species: *Laelaps agilis* Koch, 1836.

Several South American representatives of *Laelaps* occur in Panama. This is not surprising since several of the host genera occur throughout Central and South America.

KEY TO THE PANAMANIAN SPECIES OF *LAELAPS*

FEMALES

1. Gnathosomal setae at least twice as long as distal seta of coxa I
 *L. dearmasi* Furman and Tipton
- Gnathosomal setae not twice as long as distal seta of coxa I2

2. Distance between fourth pair of genito-ventral setae approximately the same as distance between first pair of genito-ventral setae*L. nuttalli* Hirst
Distance between fourth pair of genito-ventral setae much less than the distance between first pair of genito-ventral setae3
3. Distance between second pair of genito-ventral setae approximately four times greater than distance between fourth pair of genito-ventral setae
.....*L. paulistanensis* Fonseca
Distance between second pair of genito-ventral setae not more than three times greater than distance between fourth pair of genito-ventral setae4
4. Proximal seta of coxa I at least three times as wide as distal seta5
Proximal seta of coxa I less than three times as wide as distal seta ...*L. thori* Fonseca
5. Medial setae of the dorsal plate about 30 μ in length*L. pilifer* n. sp.
Medial setae of the dorsal plate about 52 μ in length*L. castroi* Fonseca

Laelaps castroi Fonseca. Plate 24.

Laelaps castroi Fonseca, 1958, Mem. Inst. Butantan, 28: 116 (Pernambuco, Brazil).

MATERIAL EXAMINED: 64 females from *O. alfaroi* and 30 females from *O. fulvescens* from Cerro Punta (Chiriquí); 13 females from *O. fulvescens* and 1 female from *Peromyscus nudipes* from Rancho Mojica (Bocas del Toro), January 1960 to March 1962, collected by C. O. Handley, C. M. Keenan and V. J. Tipton.

REMARKS: *L. castroi* may be distinguished from other species of the genus in Panama by the following combination of characters: short, robust proximal seta and a longer piliform seta on coxa I, fairly robust setae on the dorsal plate, and gnathosomal setae almost as long as the medial hypostomal setae.

Our specimens are much smaller than those from Venezuela and are not as heavily sclerotized. The length of the idiosoma as recorded by Fonseca is 670 μ , while our specimens are only 560 μ . The size and shape of the setae of coxa I vary somewhat from the figures given by Fonseca but are of the same general configuration.

Laelaps dearmasi Furman and Tipton. Plates 25, 26, 30 (figs. 4, 6, 7, 9).

Laelaps dearmasi Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle, 21, (60), pp. 187-191, pls. 8, 9.

MATERIAL EXAMINED: A total of 191 females and 7 males as follows: 139 females, 5 males from *Zygodontomys microtinus*, 20 females from *Proechimys semispinosus*, 6 females and 1 male from *Oryzomys capito*, 1 female from *O. caliginosus*, 5 females from *Rattus rattus*, 19 females and 1 male from *Sigmodon hispidus* and 1 female from "rat"; all from Canal Zone (except 16 females from Cerro Azul), July 1956 to September 1960, collected by R. M. Altman, C. M. Keenan and V. J. Tipton.

REMARKS: *L. dearmasi* is the only Panamanian species of *Laelaps* that has long, robust gnathosomal setae which extend beyond the posterior margin of the gnathosoma. Panamanian specimens differ little from Venezuelan material. The distal seta of coxa I is somewhat more robust in our specimens.

Laelaps nuttalli Hirst

Laelaps nuttalli Hirst, 1915, Bull. Ent. Res., 6: 183 (Colombo, Ceylon).

Laelaps hawaiiensis Ewing, 1924, Bull. B. P. Bishop Mus. Honolulu, 98: 118.

Haemolaelaps nuttalli Turk, 1950, Parasitology, 40, (1-2), p. 67.

MATERIAL EXAMINED: 11 females from *Rattus norvegicus*, 6 females from *Proechimys semispinosus*, plus hundreds of specimens in alcohol from *Rattus rattus*; Canal Zone, July 1959 to December 1961, collected by C. M. Keenan and V. J. Tipton.

REMARKS: *L. nuttalli* has a short, spiniform distal seta and a longer pili-form proximal seta on coxa I. The distance between the first pair of epigynial setae is about the same as the distance between the fourth pair. Specimens from Panama fall within the range of intra-specific variation for this species and are very similar to specimens from the United States.

Laelaps paulistanensis Fonseca. Plate 27.

Laelaps paulistanensis Fonseca, 1935, XII Int. Congr. Zool., p. 1610.

MATERIAL EXAMINED: 6 females from *Oryzomys alfaroi* from Cerro Punta (Chiriquí), January and February 1960, collected by C. M. Keenan and V. J. Tipton.

REMARKS: *L. paulistanensis* is the largest of the Panamanian species and as in *L. dearmasi*, its epigynial plate is greatly expanded so that the distance between the second pair of setae is at least twice as great as the distance between the fourth pair.

Our specimens are smaller (936 μ compared with 1030 μ recorded by Fonseca), the anterior setae of the dorsal plate are longer, the anal plate is broader in outline, and the anterior margin straighter than is described and figured by Fonseca (1936). However, the measurements of the ventral plates and setae and the coxal seate conform quite closely to Fonseca's description.

Laelaps pilifer Tipton, new species. Plates 28, 30 (figs. 5, 11).

DIAGNOSIS: *L. pilifer* n. sp., belongs to a species complex which includes *L. paulistanensis* Fonseca, *L. differens* Fonseca, *L. castroi* Fonseca, *L. oryzomydis* Pratt and Lane, and *L. manguinhosii* Fonseca. *L. paulistanensis* and *L. pilifer* have short delicate setae on the dorsal plate, a robust proximal seta and a piliform distal seta on coxa I. *L. paulistanensis* is a larger species (idiosoma over 1000 μ compared with 510 μ) and the distance between the second pair of epigynial setae is four times the distance between the fourth pair, while it is approximately three times in *L. pilifer*. In the latter species the distal seta of coxa I is much more delicate and the proximal seta shorter than in *L. paulistanensis*.

DESCRIPTION: *Idiosoma*.—510 μ long, by 322 μ wide.

Dorsum.—Dorsal plate elliptical, with prominent shoulders; 477 μ long by 292 μ wide; covers almost entire dorsum leaving only narrow, latero-posterior band of soft integument. Setae of dorsal plate rather delicate, not reaching to bases of setae in next row; 35 pairs; penultimate pair much smaller than medial setae; last pair longer than others; one pair of round pores adjacent to penultimate setae, an additional pair cephalad and laterad of these.

Venter.—Tritosternum bifurcate, pilose. Sternal plate 108 μ wide by 86 μ long with three pairs setae of about same length; two pairs slit-like pores. Endapodal plates rather well defined; setae about same size as sternal setae. Epigynial plate expanded, with four pairs setae; distance between first pair 80 μ , second pair 145 μ , third pair 88 μ , fourth pair 52 μ ; surface of plate with transverse lines. Metapodal plates discrete. Anal plate shield-like; 77 μ wide by 58 μ long (measured to base of postanal seta); adanal setae originate cephalad of posterior margin of anus; 31 μ long. Postanal seta 40 μ long. Approximately 10 pairs setae on unarmed venter. Peritreme reaches beyond middle of coxa II; extends posterior of stigma.

Legs.—Robust, with claws and caruncles. Leg IV longest, leg III shortest. Coxae I, III with spiniform setae; proximal seta of coxa I short, spiniform; distal seta very delicate, shorter than proximal seta. Dorsal apices of femur and genu I with setae no stronger than dorsal setae.

Gnathosoma.—Deutosternum with seven rows of two to five teeth per row. Gnathosomal setae slightly more than one-half length of medial hypostomal setae. Epipharynx long, apex rounded. Hypostome bipartite, fimbriate. Chelae well developed, toothed; fixed digit with long, slightly inflated seta. Tectum single, membranous flap; apex rounded.

TYPE MATERIAL: Holotype female from *Oryzomys capito* (field no. 7104), Río Setegantí (Darién), 5 February 1961, collected by C. M. Keenan, V. J. Tipton and C. E. Yunker. In the collection of the United States National Museum. Paratypes: 80 females from *O. capito*, 2 females from *O. caliginosus* and 1 female from *O. bombycinus*, Cerro Azul; 57 females from *O. capito*, 9 females from *Proechimys semispinosus* and 1 female from *Didelphis marsupialis*, Camp Piña (Canal Zone); 10 females from *O. capito*, Río Setegantí (Darién); 8 females from *O. capito*, Cerro Hoya (Los Santos); July 1956 to February 1962, collected by R. M. Altman, C. O. Handley, C. M. Keenan and V. J. Tipton. In the collections of the Environmental Health Branch, Canal Zone, and V. J. Tipton.

Laelaps thori Fonseca. Plates 29, 30 (figs. 1, 8).

Laelaps thori Fonseca, 1939b, Mem. Inst. Butantan, 12: 111 (transl., p. 133), fig. 5.

MATERIAL EXAMINED: 14 females from *Oryzomys albigularis* and 2 females from *Peromyscus flavidus*, Rancho Mojica (Bocas del Toro), September 1961, collected by V. J. Tipton; 3 females from *O. albigularis*, Cerro Punta (Chiriquí), February 1960, collected by C. M. Keenan and V. J. Tipton; 2 females from *O. capito*, Cerro Azul, July 1956, collected by R. M. Altman and C. M. Keenan.

REMARKS: *L. thori* has delicate dorsal setae and the proximal seta of coxa I is stout but not spiniform. A comparison of our specimens with figures given by Fonseca reveals some differences which may constitute specific characters. In our specimens the venter is more setose, the anal plate appears to be wider, and the dorsal setae are shorter and more delicate. In spite of these differences we are referring our specimens to this species.

In specimens from Cerro Azul (pl. 29) the proximal seta is shorter and thicker than in those from Rancho Mojica, and there are two or three more setae on the venter. Specimens from Cerro Punta are closer to Fonseca's figures than those from Rancho Mojica and the Rancho Mojica specimens are closer than those from Cerro Azul. This entire series is probably conspecific and may even be an extension of the *L. pilifer-castroi* complex.

Laelaps species. Plate 30 (figs. 2, 10).

MATERIAL EXAMINED: A single female from *Oryzomys bicolor*, Camp Piña (Canal Zone), 29 August 1956, collected by R. M. Altman and C. M. Keenan.

REMARKS: This specimen differs markedly from *L. pilifer* n. sp. in that the gnathosomal setae are minute, the proximal seta of coxa I is setiform, not spiniform and the pilus dentilis is inflated as in *Haemolaelaps*. Although it probably represents an undescribed species of *Laelaps*, we shall await further material before making a decision as to its disposition.

Comments on the Genus *Laelaps*

We are not satisfied with this arrangement of the *Laelaps* species. It is only tentative. We lack basic biological information—e.g., on host specificity, ecological and geographical patterns, and morphological changes in relation to age—essential to an understanding of the systematics of a taxon. Apparently the species of this genus have a wide geographic range.

Within a large group of specimens, the *castroi-pilifer-thori* complex, there are several more or less distinct subgroups. The characters which separate the species of the complex are not clearly defined and there is extreme variation within a long series from the same host specimen. Characters thought to be constant in this genus, e.g., shape and size of coxal setae, plate size and shape and details of the chelicerae, are variable even on the same specimen. If one could obtain specimens from enough localities a few miles apart, it is possible that one would find clines of characters throughout Central and South America. Many species now regarded as distinct might prove to represent population differences along these clines.

Genus *Mysolaelaps* Fonseca

Mysolaelaps Fonseca, 1935, Mem. Inst. Butantan, 10: 17.

Type-species: *Mysolaelaps parvispinosus* Fonseca, 1935.

We have collected only one species of *Mysolaelaps* although a second is probably present. *Mysolaelaps heteronychus* Fonseca occurs on a species of *Rhipidomys* in Venezuela. We have been unable to collect this host in Panama, although one species is represented in the fauna.

Mysolaelaps parvispinosus Fonseca. Plate 31.

Mysolaelaps parvispinosus Fonseca, 1936, Mem. Inst. Butantan, 10: 17. (São Paulo, Brazil).

MATERIAL EXAMINED: 2 females from *Oryzomys capito*, El Valle, 27 March 1957, and 3 females from *O. fulvescens*, Cerro Jefe, 7 February 1958, collected by R. M. Altman and C. M. Keenan.

REMARKS: *Mysolaelaps parvispinosus* is readily separated from the other two neotropical species of *Mysolaelaps*. The genito-ventral setae of *M. heteronychus* are minute and approximately equal in size, while in *M. parvispinosus* the first pair of genito-ventral setae are much smaller than the last three pairs. The sternal setae of *M. microspinosus* are small and ap-

proximately equal in size whereas the first pair of sternal setae of *M. parvispinosus* are small, the second and third pairs are more robust and are more than twice as long as the first pair.

The first pair of epigynial setae measure 68 to 80 μ long whereas they were only 57 μ long in specimens from Brazil and Venezuela. The fourth pair of epigynial setae are more widely separated in our specimens (169-198 μ ; mean of five specimens, 175 μ) than in Venezuelan specimens (130 to 156 μ ; mean of five specimens, 151 μ). Although our series is small there appears to be considerable variation in this species.

Genus *Steptolaelaps* Furman

Steptolaelaps Furman, 1955b, Jour. Parasit., 41, (5), p. 519.

Type-species: *Neolaelaps heteromys* Fox.

Only one species of this genus has been collected in Panama.

Steptolaelaps heteromys (Fox). Plates 32, 33.

Neolaelaps heteromys Fox, 1947, Zoologica, 32, (3), pp. 117-119 (Venezuela).

Steptolaelaps heteromydis Furman, 1955b, Jour. Parasit., 41, (5), p. 521.

Steptolaelaps heteromys Furman and Tipton, 1961, Mem. Soc. Cienc. Nat. La Salle; 21, (60), p. 195.

MATERIAL EXAMINED: 7 males and 43 females from *Heteromys desmarestianus*; 23 males, 71 females and 2 nymphs from *H. australis*; 4 females from *Liomys adspersus*; 2 females from *Oryzomys* sp.; 1 female from *Tylomys panamensis*; from the Canal Zone, Río Setegantí, Cerro Azul, and El Valle; March 1957, January and February 1958, January and October 1960, collected by R. M. Altman, C. M. Keenan, V. J. Tipton and C. E. Yunker.

REMARKS: *S. heteromys* is distinct from the only other species of the genus, *S. liomydis*, in having long and tapering (rather than short) gnathosomal setae and in details of the female chelicerae (Furman, 1955b). The adanal setae in our specimens appear to be slightly longer than in those figured by Furman (1955b). Otherwise, our specimens are remarkable for their lack of variation.

These mites are most commonly associated with heteromyid rodents and have been collected most frequently at elevations below 3000 feet. We have collected 76 specimens of *Heteromys desmarestianus* at elevations above 3000 feet. None of them harbored *S. heteromys*.

Genus *Tur* Baker and Wharton

Protonyssus Turk, 1946, Ann. Mag. Nat. Hist., (11), 13: 347.

Tur Baker and Wharton, 1952, Introd. Acar., p. 85 (new name for *Protonyssus* Turk, not *Protonyssus* Trouessart, 1915). Furman and Tipton, 1958, Jour. Parasit., 44, (5), pp. 541-7 (redescription of genus).

Type-species: by original designation and monotypy, *Protonyssus uniscutatus* Turk.

A new species, described below, possesses characteristics of both *Laelaps* and *Tur*. This has raised serious doubts as to the validity of the genus *Tur*. However, we choose to recognize it for the time being.

Tur anomalus Tipton, new species. Plates 30 (figs. 3, 12), 34.

DIAGNOSIS: *Tur anomalus* n. sp., runs to *T. lativentralis* (Fonseca) in the key provided by Furman and Tipton (1961). It is similar to that species in that the anal plate is separate from the epigynial plate and the gnathosomal and hypostomal setae are reduced in both species. However, *T. anomalus* is only 525 μ long whereas *T. lativentralis* is more than 1000 μ . In addition, the setae of coxa I are very short and robust and the adanal setae do not reach the base of the postanal seta in *T. anomalus*, while the setae of coxa I are at least half the length of the coxa and the adanal setae reach beyond the base of the postanal seta in *T. lativentralis*.

DESCRIPTION: *Idiosoma*.—525 μ long by 309 μ wide.

Dorsum.—Dorsal plate strongly elliptical, with prominent shoulders; 504 μ long by 260 μ wide; does not cover entire dorsum, with narrow postero-lateral band of soft integument. Setae of dorsal plate in definite pattern; 39 pairs setae; some reticulation adjacent to bases of setae.

Venter.—Tritosternum pilose. Sternal plate 128 μ wide by 109 μ long. Anterior margin straight, posterior margin slightly convex; three pairs sternal setae of approximately same length; two pairs slit-like pores. Endapodal plates fairly well defined; setae slightly longer than sternal setae. Metapodal plates elliptical. Epigynial plate expanded; with four pairs of setae; distance between first pair of setae 62 μ , second pair 108 μ , third pair 126 μ , fourth pair 92 μ ; posterior margin truncate, in juxtaposition with anal plate. Anal plate broadly triangular with straight anterior margin; 92 μ wide by 71 μ long (measured to base of postanal seta); adanal setae with bases cephalad of posterior margin of anus; 24 μ long; postanal seta 28 μ long. Approximately nine pairs of setae on unarmed portion of venter. Peritremalia posterior to stigmata broad, lying in juxtaposition with parapodal plates which partially encircle coxae IV; peritremes sinuate, reaching to anterior margin of coxae II.

Legs.—Coxa I with two stout, striated, spiniform setae; proximal seta longer than distal seta; spiniform setae on coxae II and III; femur I with strong spiniform seta on ventral surface, two strong setae on dorsal surface. Legs I and II more robust than other legs; leg IV longest, leg III shortest.

Gnathosoma.—Deutosternum with usual rows of teeth. Gnathosomal setae slightly coarser than medial hypostomal setae. Epipharynx tongue-like, with medial groove. Details of the chelicerae not readily discernible but long seta at base of chela; chelae toothed; pilus dentilis apparently absent.

TYPE MATERIAL: Holotype female from *Hoplomys gymnurus* (field no. 4038), Cerro Azul (Panama), 29 January 1958, collected by R. M. Altman and C. M. Keenan. In the collection of the United States National Museum. Eleven paratype females, same data and repository as the holotype.

REMARKS: *T. anomalus* exhibits even more characteristics of *Laelaps* than does *T. lativentralis*. The gnathosomal and hypostomal setae are reduced. The posterior margin of the sternal plate is not deeply invaginated and the setae of the dorsal plate as well as of the venter are not robust as in other species of the genus. The broad peritremalia, the anal plate lying in juxtaposition with the epigynial plate and the details of the female chelicerae, though not clearly visible, show some affinities with other species of *Tur*. The discovery of this species emphasizes again (Furman and Tipton, 1961) that the differences between *Tur* and *Laelaps* are not as marked as was first supposed.

Tur uniscutatus (Turk). Plates 35, 36.

Protonyssus uniscutatus Turk, 1946, Ann. Mag. Nat. Hist., (11), 13: 347.

Tur uniscutatus Baker and Wharton, 1952, Introd. Acar., p. 85. Furman and Tipton, 1958, Jour. Parasit., 44 (5), pp. 541-547.

MATERIAL EXAMINED: 1228 females and 43 males from *Proechimys semispinosus* from the Canal Zone; 303 females from *P. semispinosus* from Almirante (Bocas del Toro) and 21 females and 1 male from *P. semispinosus* from Cerro Azul; 16 females from *Didelphis marsupialis*, 3 females from *Marmosa robinsoni*, 1 female from *Philander opossum* and 1 female from *Heteromys desmarestianus*, Camp Piña (Canal Zone); 13 females from *Nasua nasua*, Gamboa (Canal Zone); 6 females from *Hoplomys gymnurus*, Cerro Azul and Almirante; 13 females from "rat", Barro Colorado Island; collected from July 1956 to July 1960 by R. M. Altman, C. O. Handley, C. M. Keenan and V. J. Tipton.

REMARKS: More than 95 percent of our 1649 specimens are from *Proechimys semispinosus*. Although this represents a long series, the range of variation is not as great as in species of other neotropical genera. Plates 35 and 36 show the extremes in variation, mostly differences in the diameter of the gnathosomal setae, size and number of setae on the venter, and minor differences in the details of the female chelicerae. Figures of Panamanian specimens given by Furman and Tipton (1958) differ slightly from our illustrations in these same characters. A study of all the specimens from which the drawings were made reveals that the differences are not as great as the illustrations indicate. However, specimens from Bocas del Toro do have heavier body setae and the female holoventral plate is slightly more expanded than in specimens from other localities.

HOST-PARASITE LIST

Class MAMMALIA

Order MARSUPIALIA

Family Didelphidae

Marmosa robinsoni*Tur uniscutatus* (Turk)**Didelphis marsupialis***Gigantolaelaps inca* Fonseca" *oudemansi* Fonseca*Laelaps pilifer* n. sp.*Tur uniscutatus* (Turk)*Haemolaelaps glasgowi* (Ewing)**Philander opossum***Tur uniscutatus* (Turk)*Haemolaelaps glasgowi* (Ewing)**Metachirus nudicaudatus***Haemolaelaps glasgowi* (Ewing)

Order RODENTIA

Suborder Sciuromorpha

Family Sciuridae

Sciurus granatensis*Haemolaelaps glasgowi* (Ewing)

Family Heteromyidae

Heteromys australis*Steptolaelaps heteromys* (Fox)*Haemolaelaps glasgowi* (Ewing)**Heteromys desmarestianus***Steptolaelaps heteromys* (Fox)*Eubrachylaelaps jamesoni* Furman*Tur uniscutatus* (Turk)*Haemolaelaps glasgowi* (Ewing)**Liomys adspersus***Steptolaelaps heteromys* (Fox)*Haemolaelaps glasgowi* (Ewing)

Suborder Myomorpha

Family Cricetidae

Oryzomys albigularis*Gigantolaelaps inca* Fonseca*Laelaps thori* Fonseca**Oryzomys alfaroi***Gigantolaelaps gilmorei* Fonseca" *inca* Fonseca" *oudemansi* Fonseca*Laelaps castroi* Fonseca" *paulistanensis* Fonseca*Haemolaelaps glasgowi* (Ewing)**Oryzomys bicolor***Gigantolaelaps oudemansi* Fonseca*Laelaps* sp.**Oryzomys bombycinus***Gigantolaelaps gilmorei* Fonseca" *oudemansi* Fonseca*Laelaps pilifer* n. sp.*Haemolaelaps glasgowi* (Ewing)**Oryzomys caliginosus***Gigantolaelaps gilmorei* Fonseca" *oudemansi* Fonseca" *wolffsohni* (Oudemans)*Laelaps dearmasi* Furman and Tipton" *pilifer* n. sp.*Haemolaelaps glasgowi* (Ewing)**Oryzomys capito***Gigantolaelaps gilmorei* Fonseca" *oudemansi* Fonseca" *wolffsohni* (Oudemans)*Haemolaelaps glasgowi* (Ewing)*Laelaps dearmasi* Furman and Tipton" *pilifer* n. sp." *thori* Fonseca*Mysolaelaps parvispinosus* Fonseca**Oryzomys fulvescens***Gigantolaelaps oudemansi* Fonseca" *wolffsohni* (Oudemans)*Eubrachylaelaps jamesoni* Furman*Laelaps castroi* Fonseca*Mysolaelaps parvispinosus* Fonseca*Haemolaelaps glasgowi* (Ewing)**Oryzomys** sp.*Steptolaelaps heteromys* (Fox)**Nectomys alfari***Gigantolaelaps gilmorei* Fonseca" *oudemansi* Fonseca" *wolffsohni* (Oudemans)*Echinolaelaps lowei* n. sp.*Haemolaelaps glasgowi* (Ewing)**Tylomys panamensis***Steptolaelaps heteromys* (Fox)*Haemolaelaps glasgowi* (Ewing)**Nyctomys sumichrasti***Haemolaelaps glasgowi* (Ewing)**Reithrodontomys creper***Eubrachylaelaps jamesoni* Furman*Haemolaelaps glasgowi* (Ewing)**Reithrodontomys mexicanus***Haemolaelaps glasgowi* (Ewing)

Reithrodontomys sumichrasti*Gigantolaelaps gilmorei* Fonseca*Haemolaelaps glasgowi* (Ewing)**Peromyscus flavidus***Gigantolaelaps inca* Fonseca" *oudemansi* Fonseca*Laelaps thori* Fonseca**Peromyscus nudipes***Eubrachylaelaps jamesoni* Furman*Gigantolaelaps inca* Fonseca*Laelaps castroi* Fonseca*Haemolaelaps glasgowi* (Ewing)**Zygodontomys microtinus***Gigantolaelaps gilmorei* Fonseca" *goyanensis* Fonseca" *oudemansi* Fonseca" *wolffsohni* (Oudemans)*Laelaps dearmasi* Furman and Tipton*Haemolaelaps glasgowi* (Ewing)**Scotinomys teguina***Haemolaelaps glasgowi* (Ewing)**Scotinomys xerampelinus***Haemolaelaps glasgowi* (Ewing)**Sigmodon hispidus***Gigantolaelaps gilmorei* Fonseca" *oudemansi* Fonseca" *wolffsohni* (Oudemans)*Laelaps dearmasi* Furman and Tipton*Haemolaelaps glasgowi* (Ewing)

Family Muridae

Rattus norvegicus*Laelaps nuttalli* Hirst**Rattus rattus***Echinolaelaps echidninus* (Berlese)*Laelaps dearmasi* Furman and Tipton" *nuttalli* Hirst*Haemolaelaps glasgowi* (Ewing)

Suborder Hystricomorpha

Family Echimyidae

Proechimys semispinosus*Tur uniscutatus* (Turk)*Gigantolaelaps gilmorei* Fonseca*Laelaps dearmasi* Furman and Tipton" *nuttalli* Hirst" *pilifer* n. sp.*Haemolaelaps glasgowi* (Ewing)**Hoplomys gymnurus***Tur uniscutatus* (Turk)" *anomalus* n. sp.*Haemolaelaps glasgowi* (Ewing)

Order CARNIVORA

Family Procyonidae

Nasua nasua*Tur uniscutatus* (Turk)

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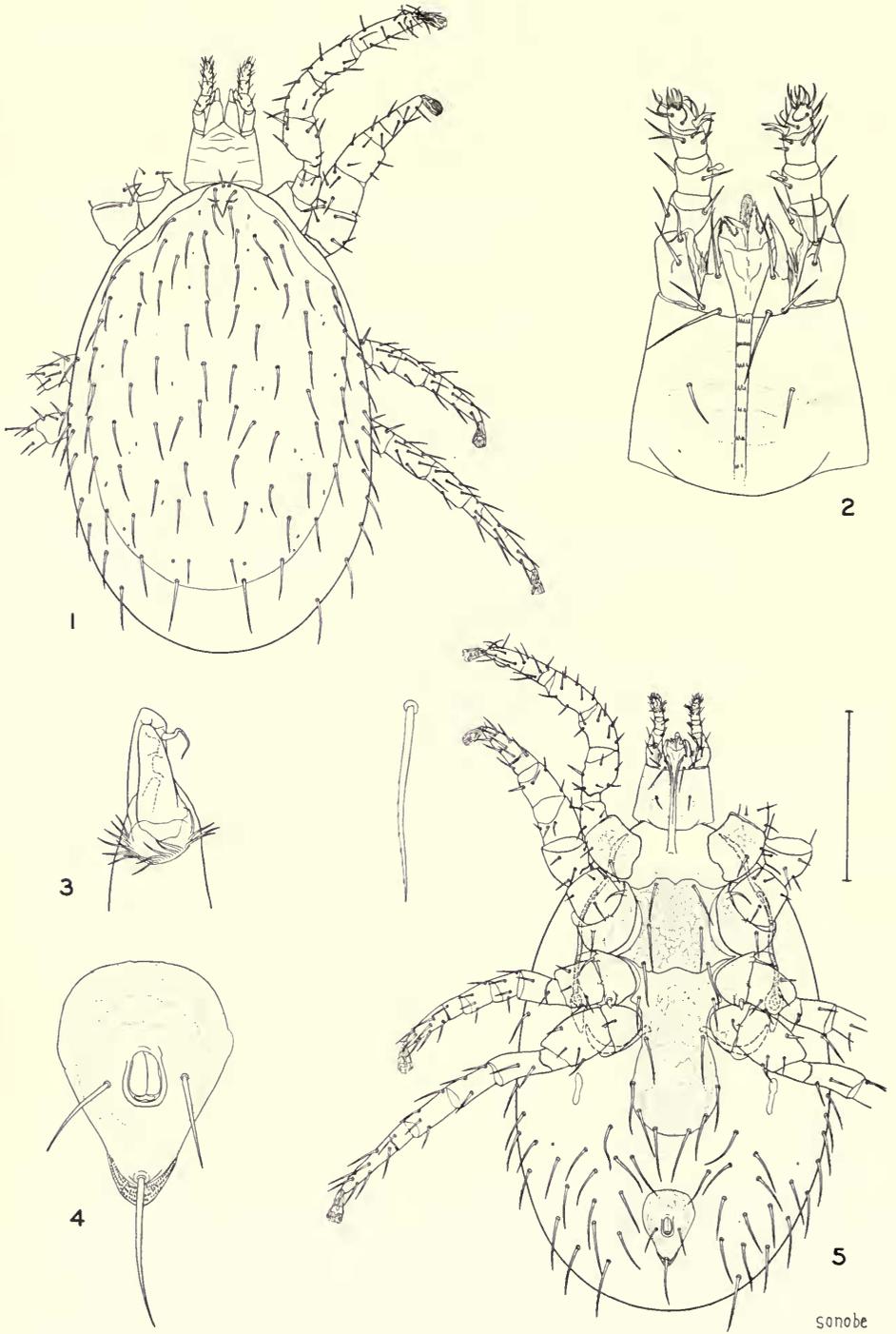
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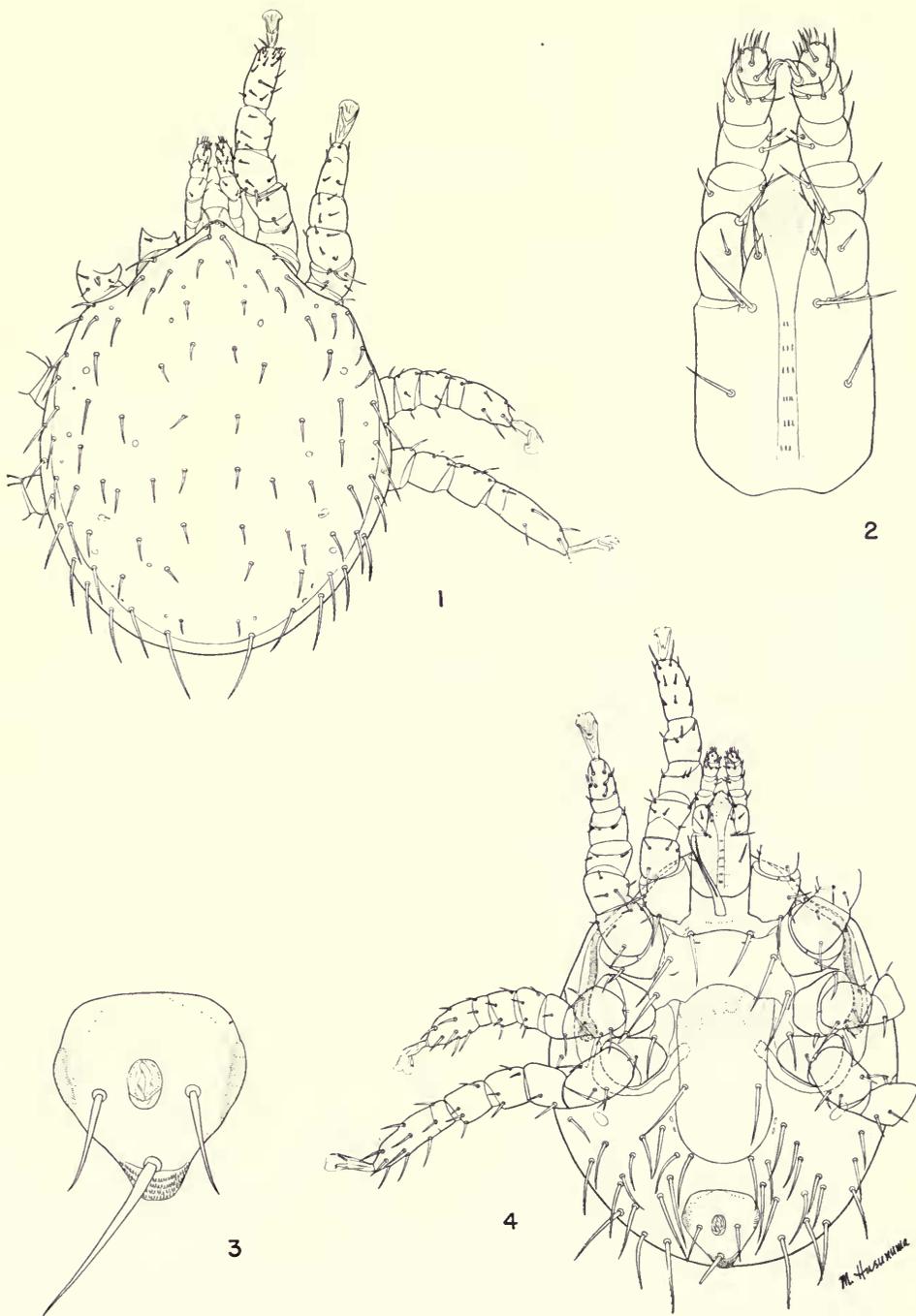
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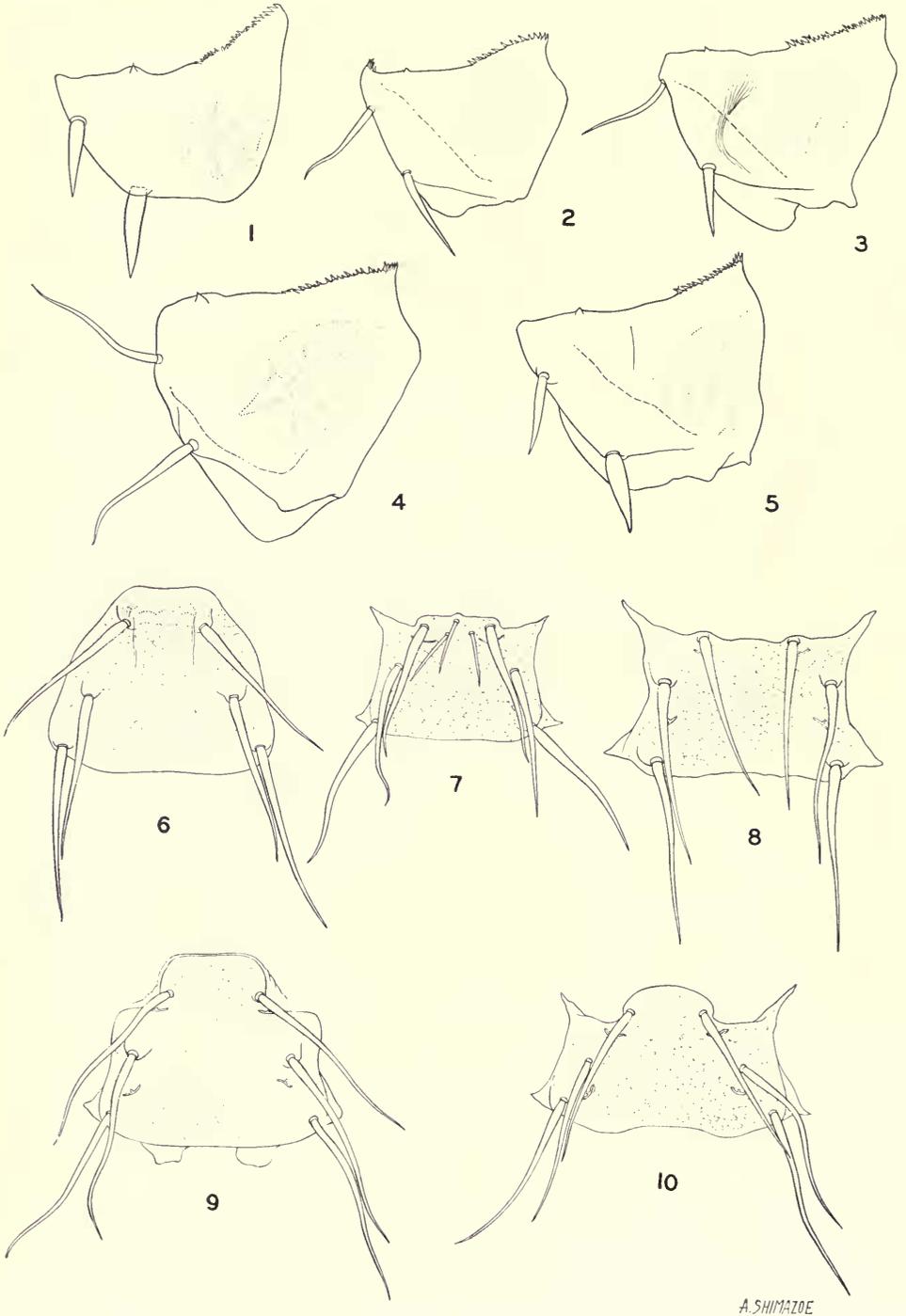
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Echinolaelaps lowei Tipton, new species, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.

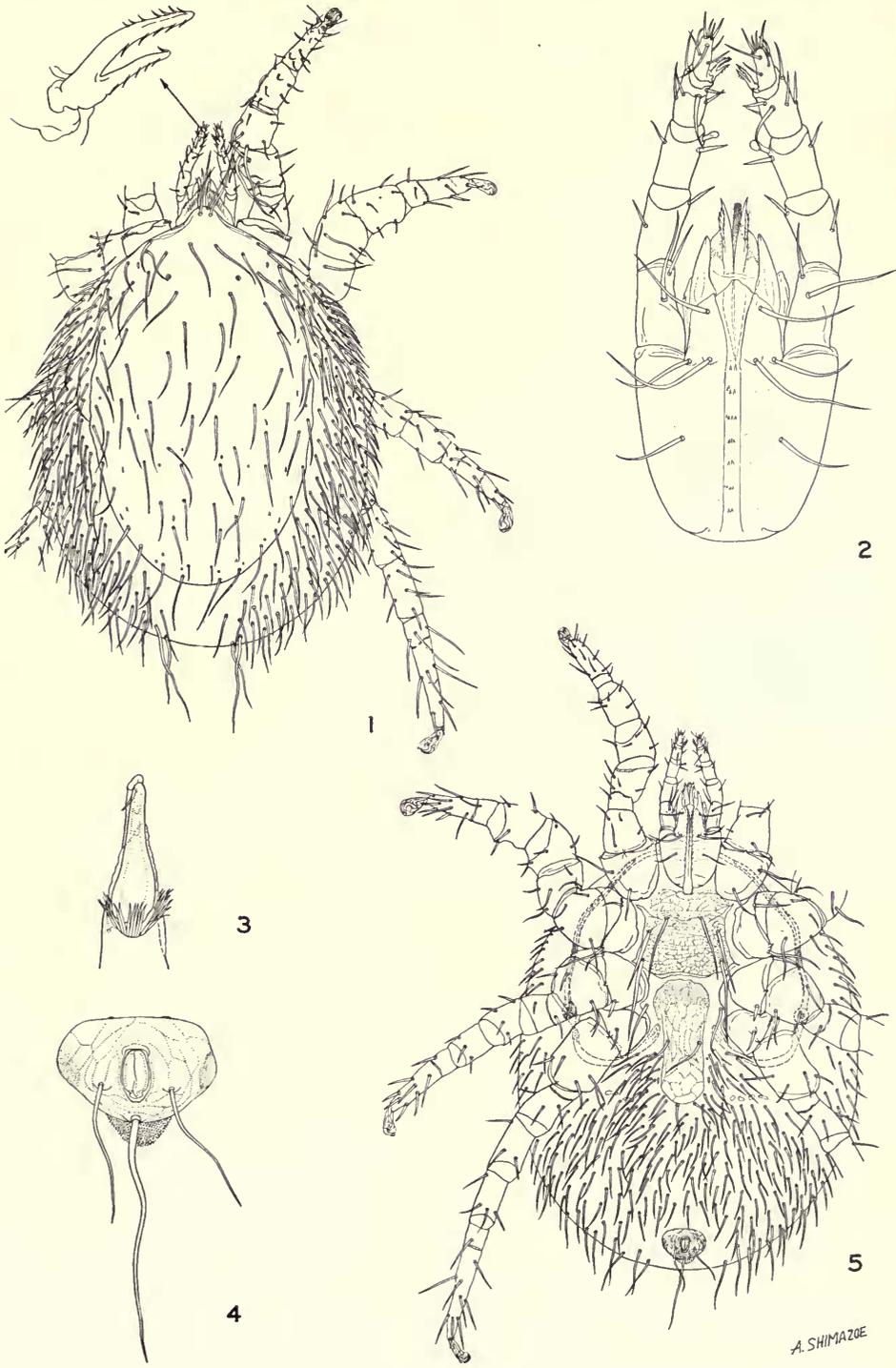


Eubrachylaclaps jamesoni Furman, female. 1, dorsal view. 2, gnathosoma. 3, anal plate. 4, ventral view.

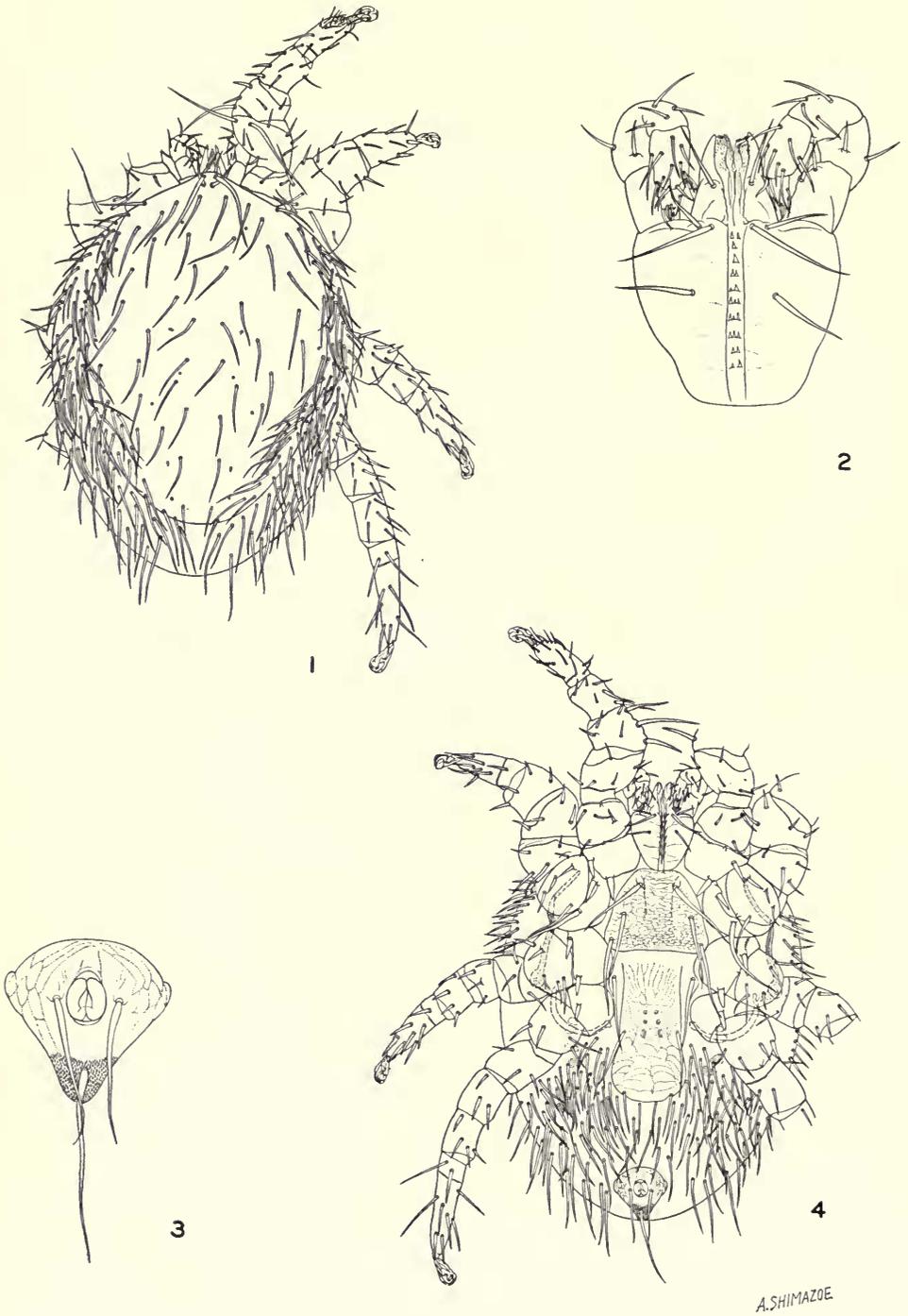


A. SHIMAZOE

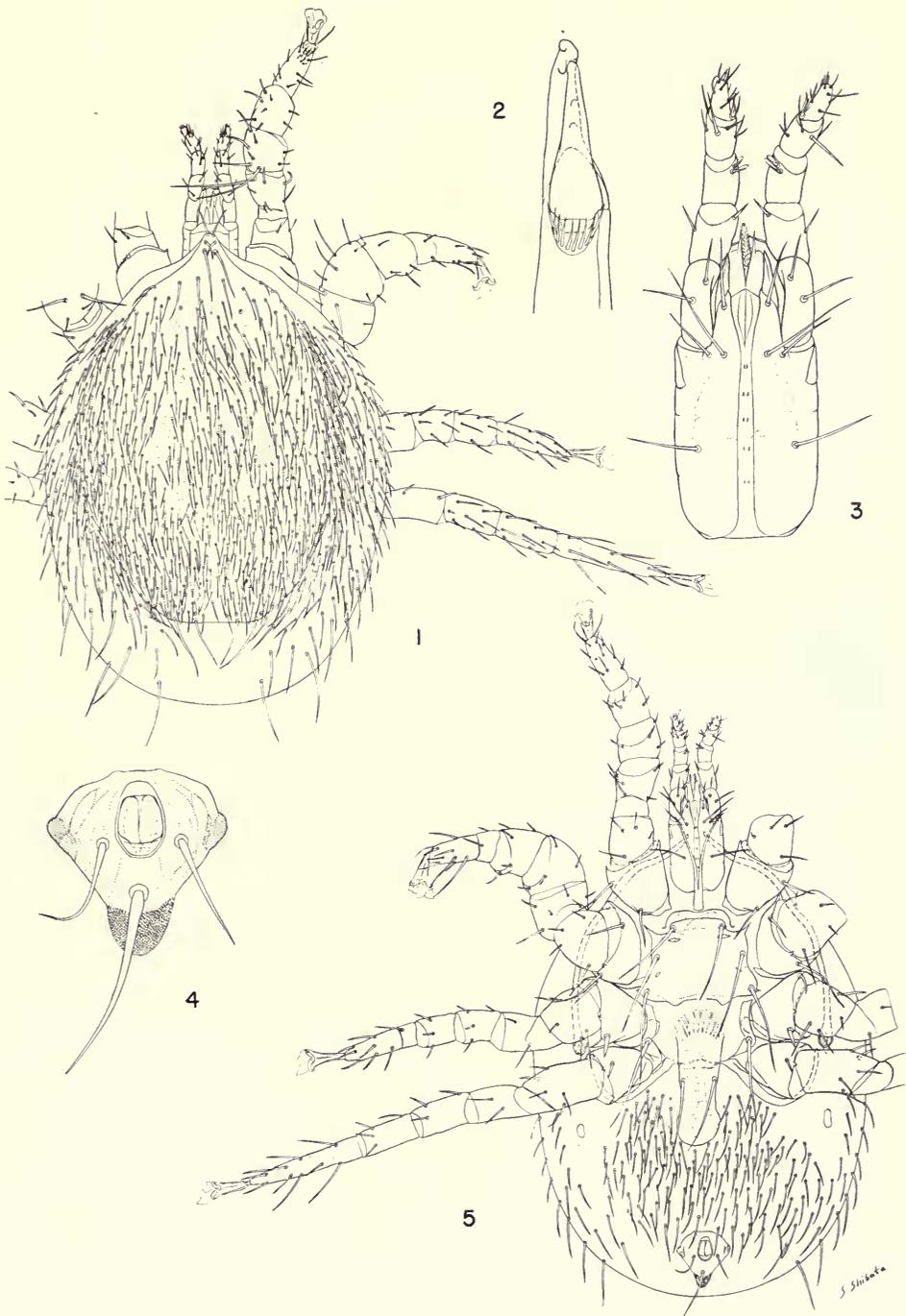
Coxa I and sternal plates. *Gigantolaelaps gilmorei* Fonseca (figs. 4, 8). *G. goyanensis* Fonseca (figs. 1, 6). *G. oudemansi* Fonseca (figs. 2, 7). *G. wolffsohni* (Oudemans) (figs. 3, 5, 9, 10).



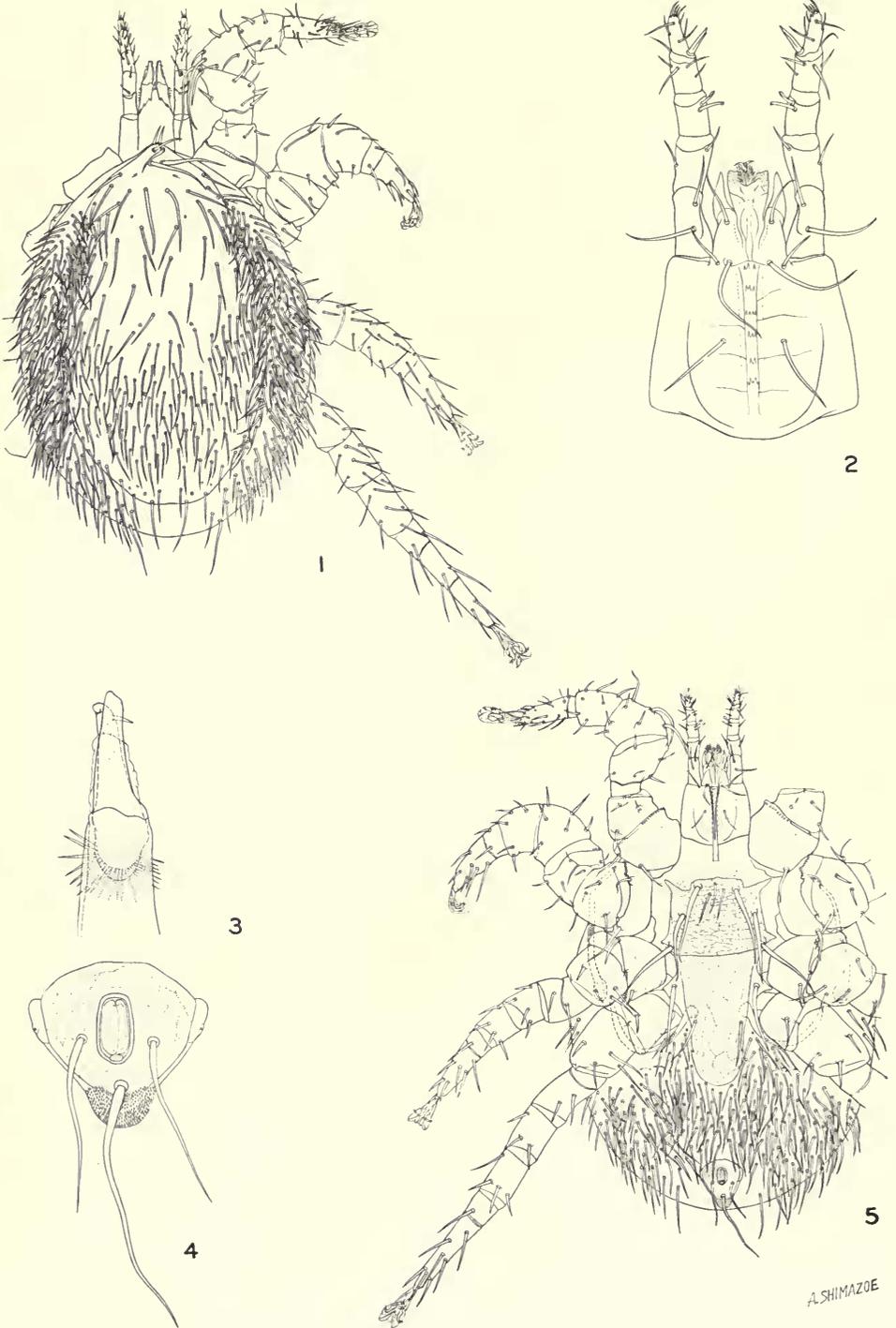
Gigantolaelaps gilmorei Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



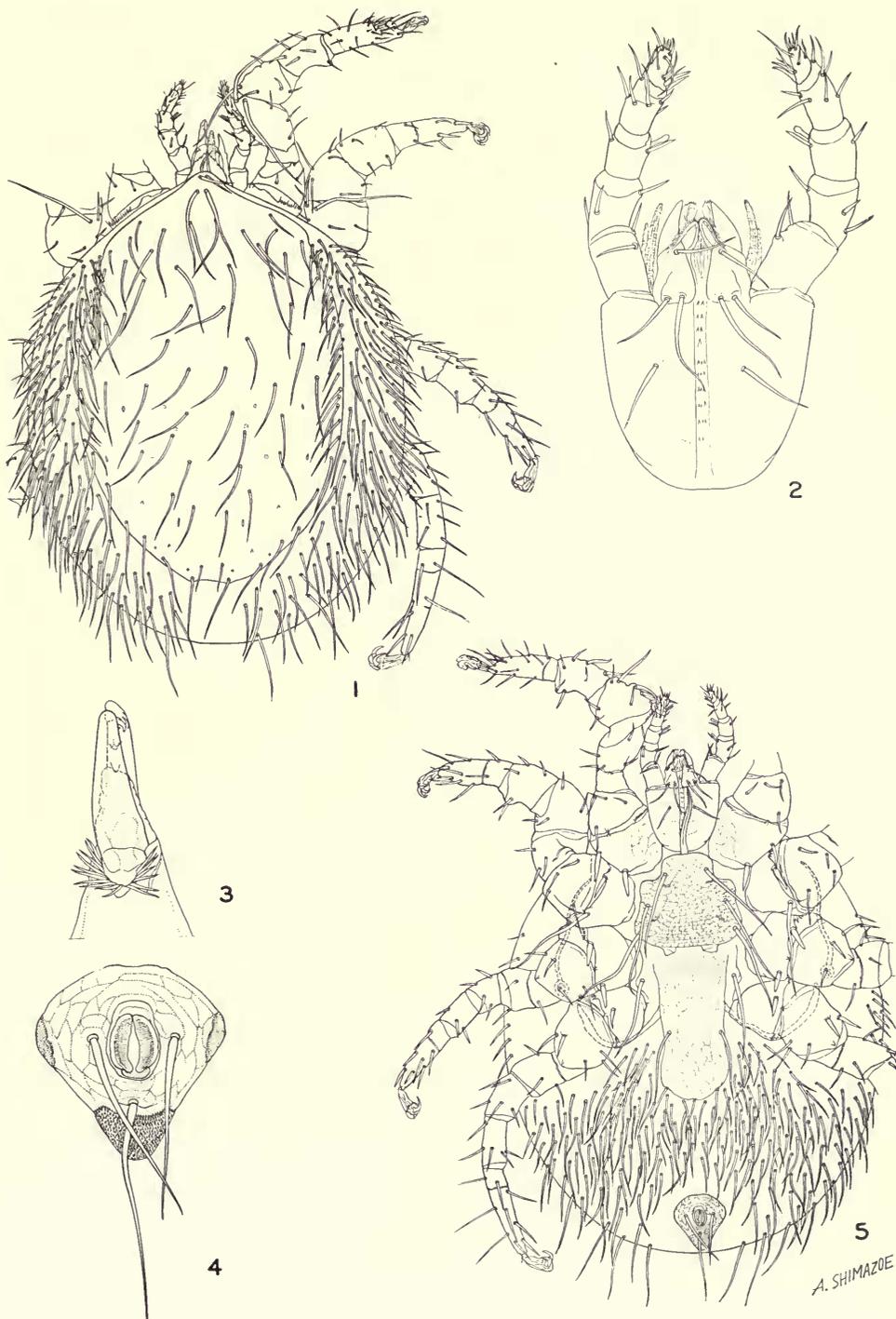
Gigantolaelaps goyanensis Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, anal plate. 4, ventral view.



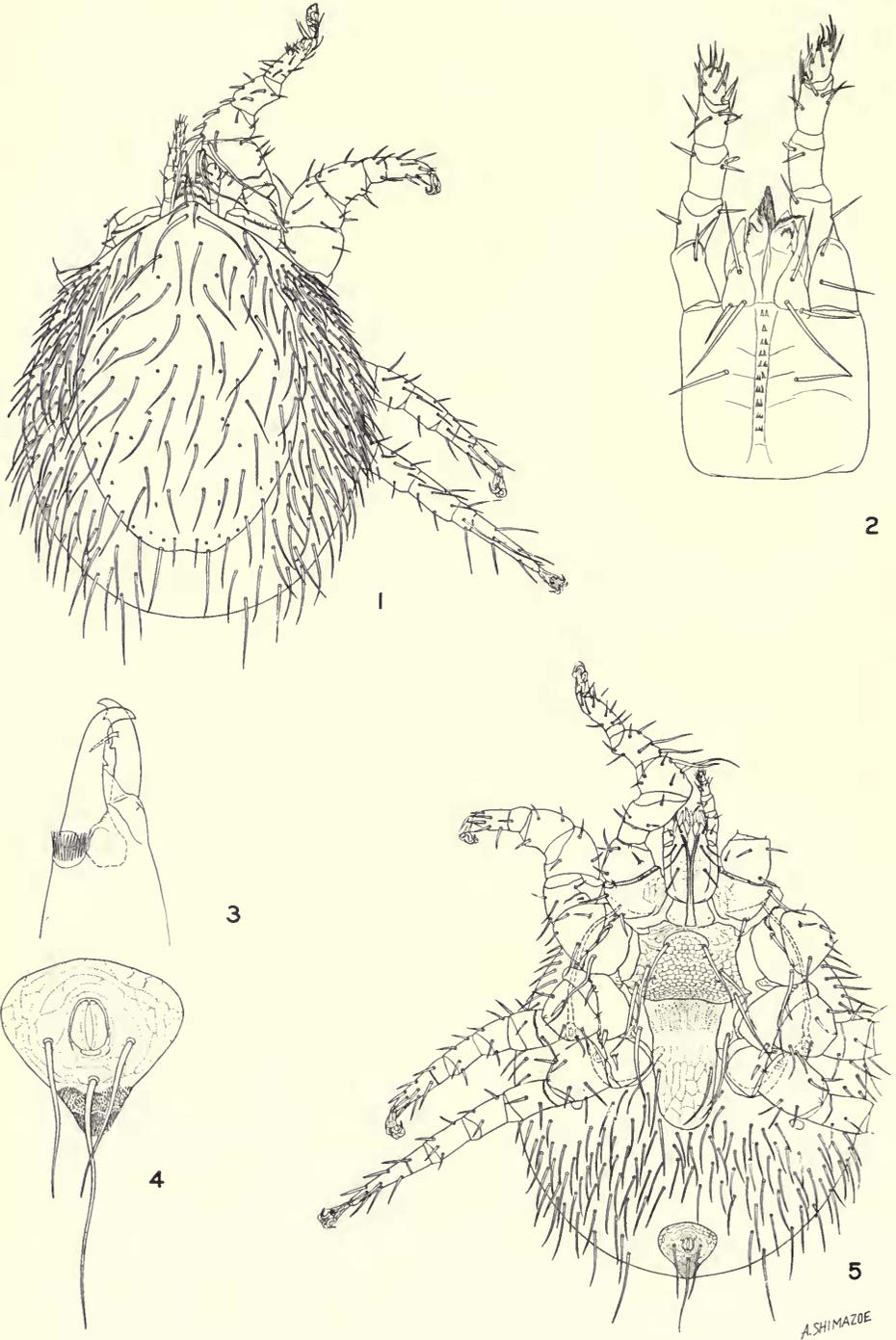
Gigantolaelaps inca Fonseca, female. 1, dorsal view. 2, chela. 3, gnathosoma. 4, anal plate. 5, ventral view.



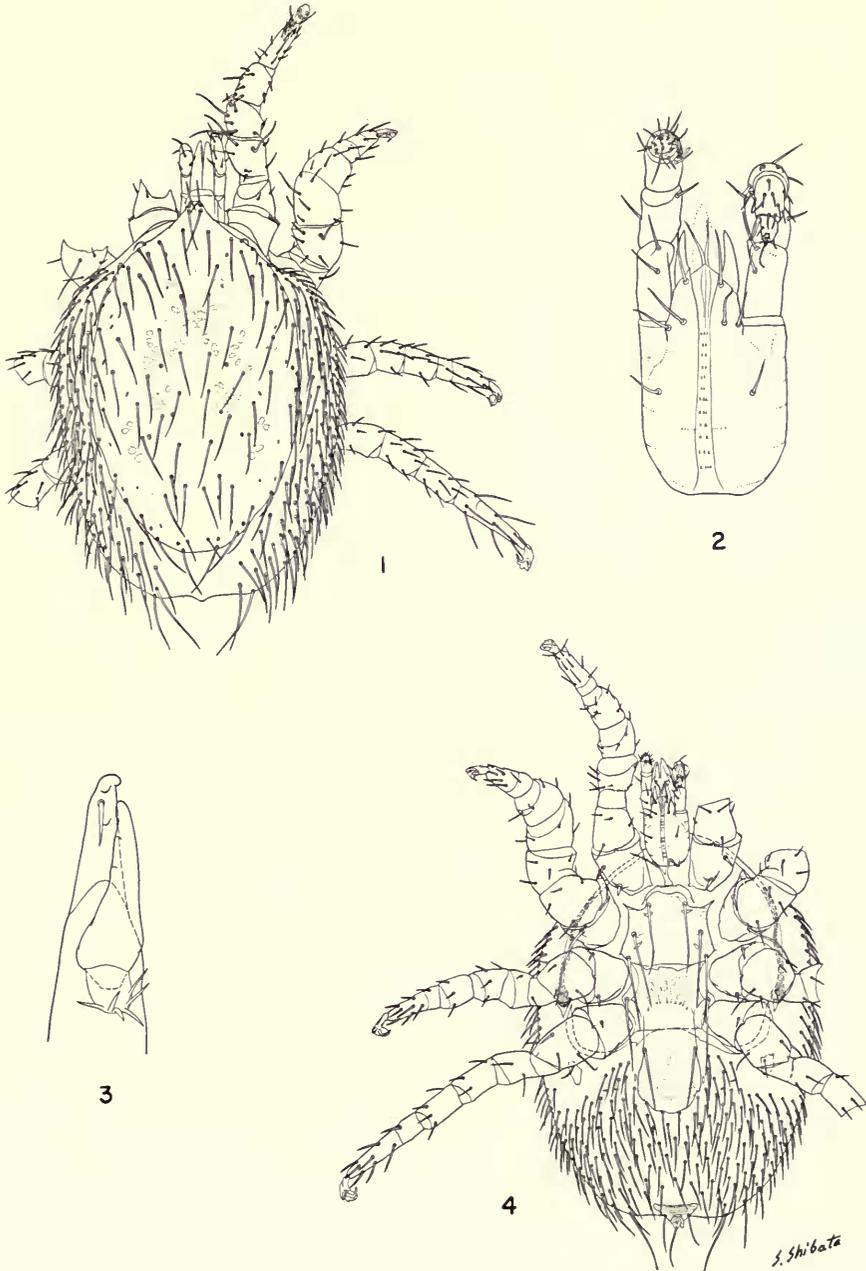
Gigantolaelaps oudemansi Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



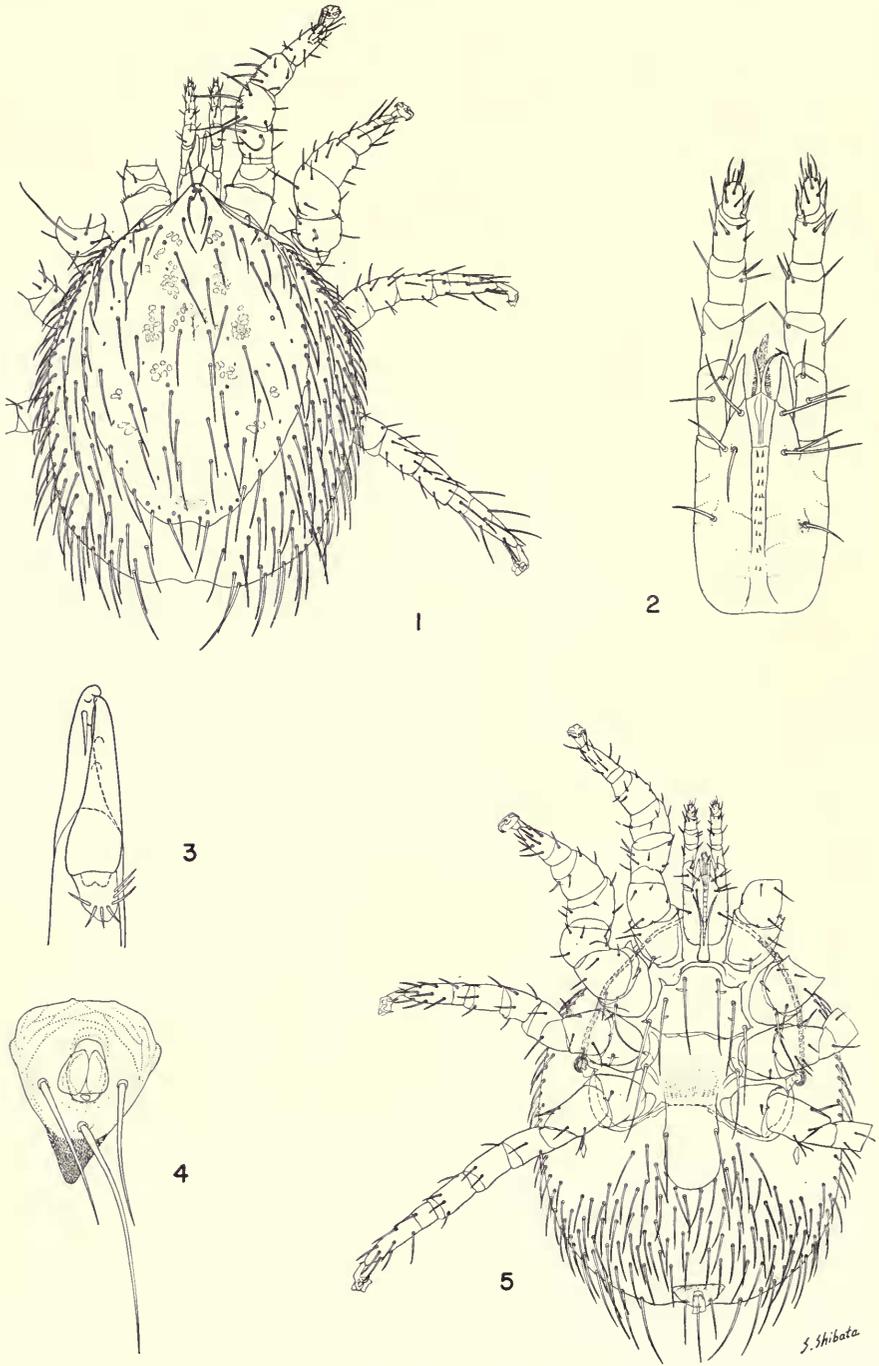
Gigantolaelaps wolffsohni (Oudemans), female, group A, from *Oryzomys caliginosus*, Cerro Campana. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



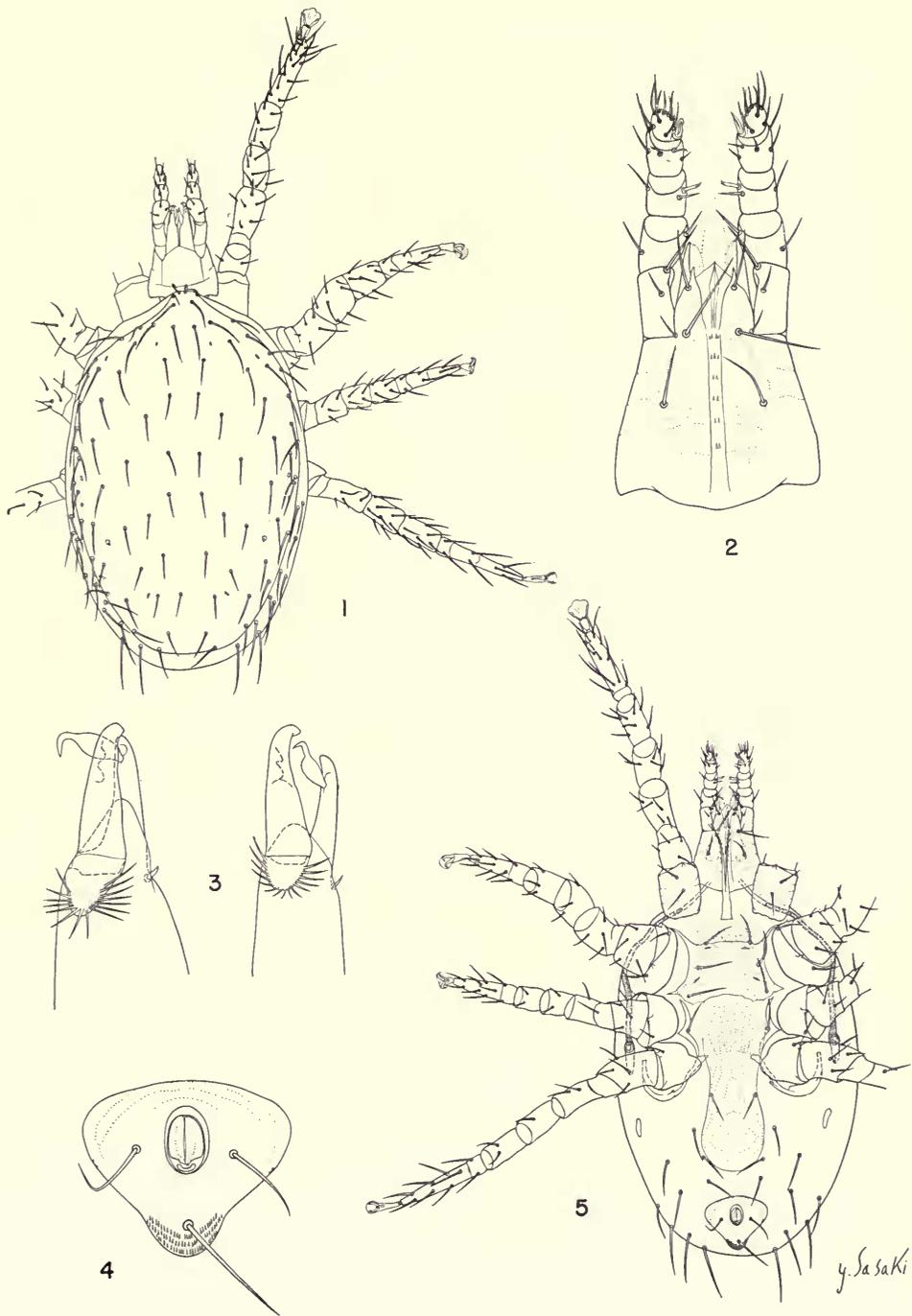
Gigantolaelaps wolffsohni (Oudemans), female, group B, from *Oryzomys capito* El Valle. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



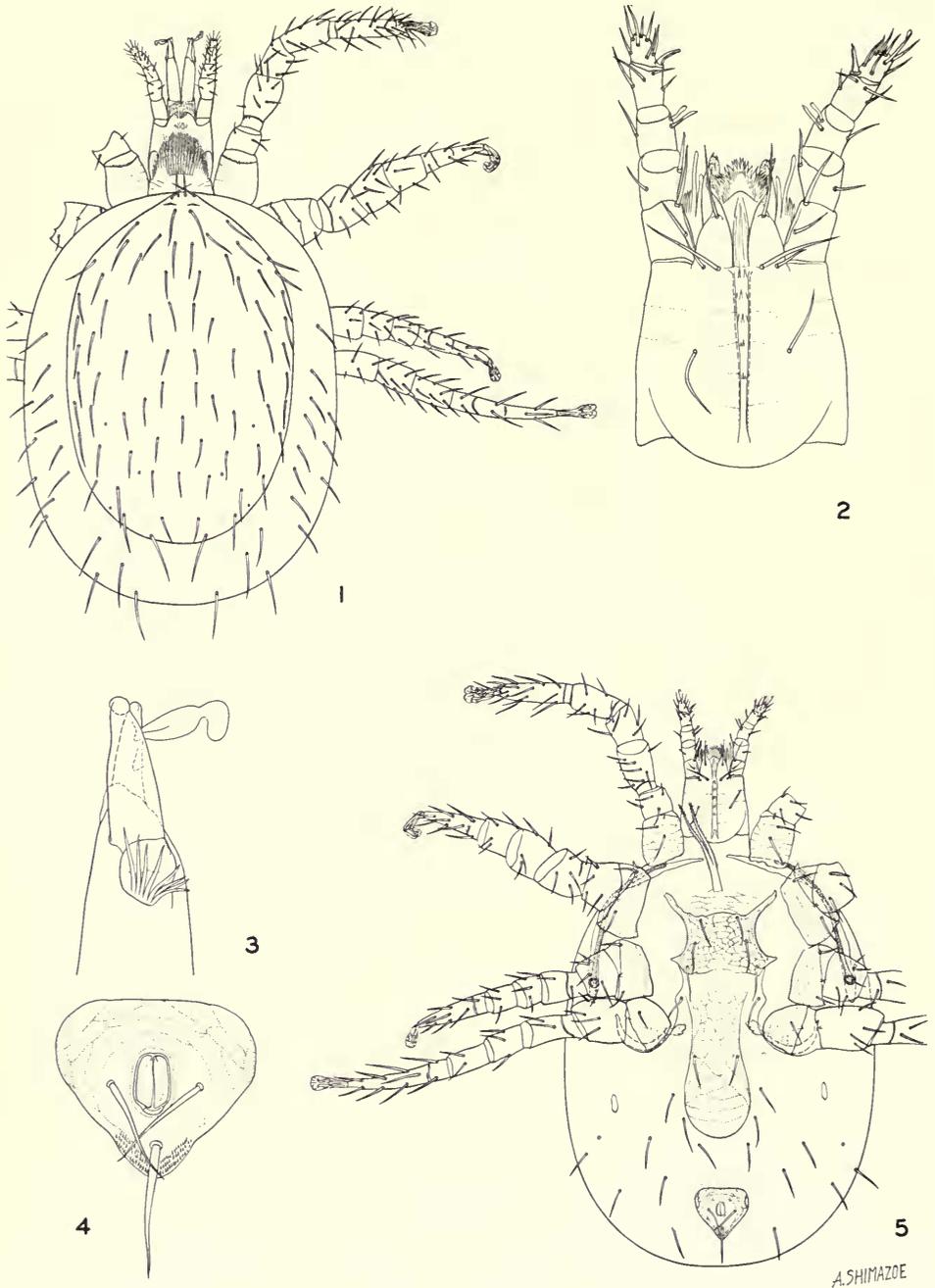
Gigantolaelaps wolffsohni (Oudemans), female, group C, from *Sigmodon hispidus*, Almirante. 1, dorsal view. 2, gnathosoma. 3, chela. 4, ventral view.



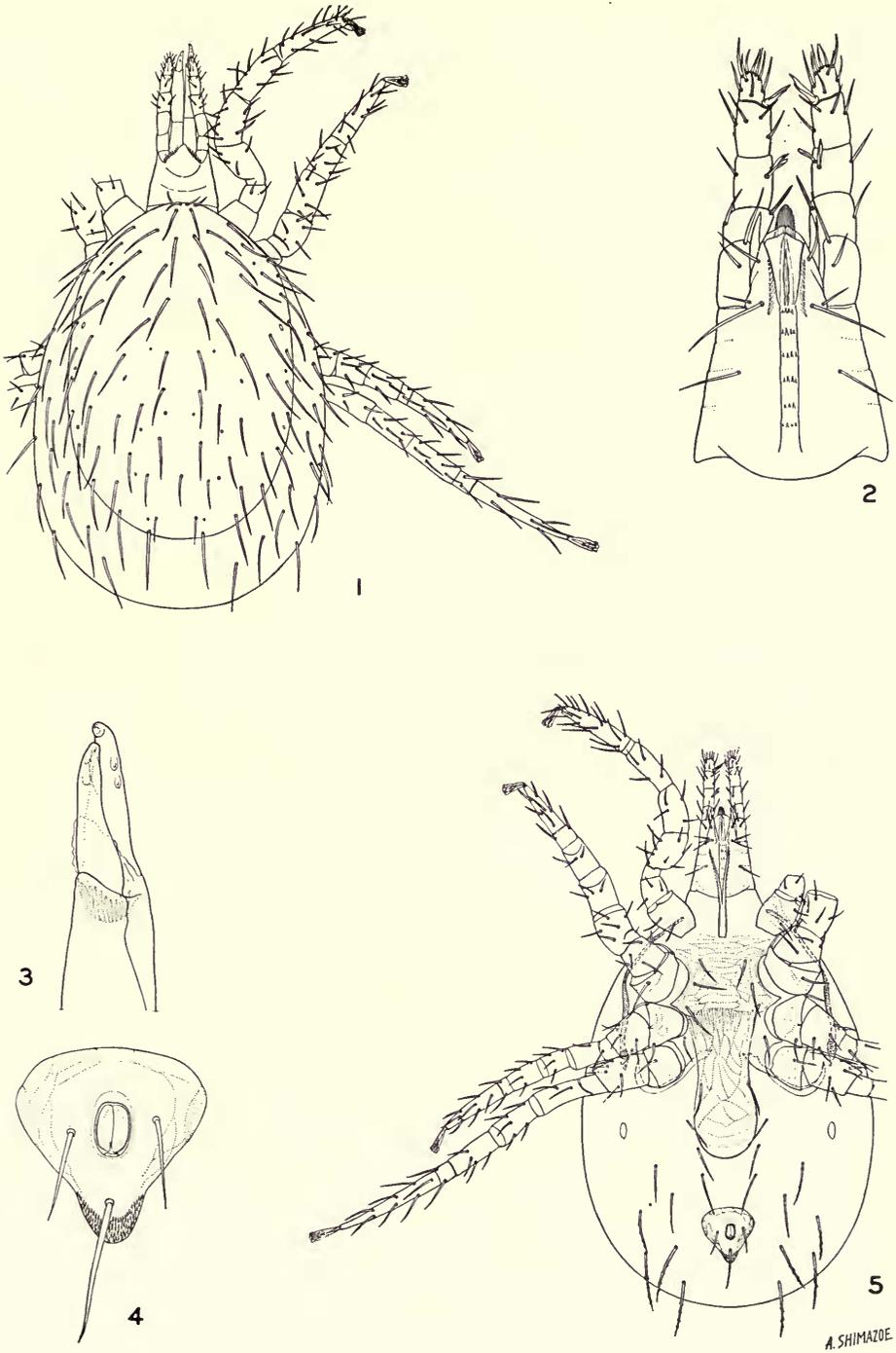
Gigantolaelaps wolffsohni (Oudemans), female, group D, from *Oryzomys fulvescens*, Rancho Mojica. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



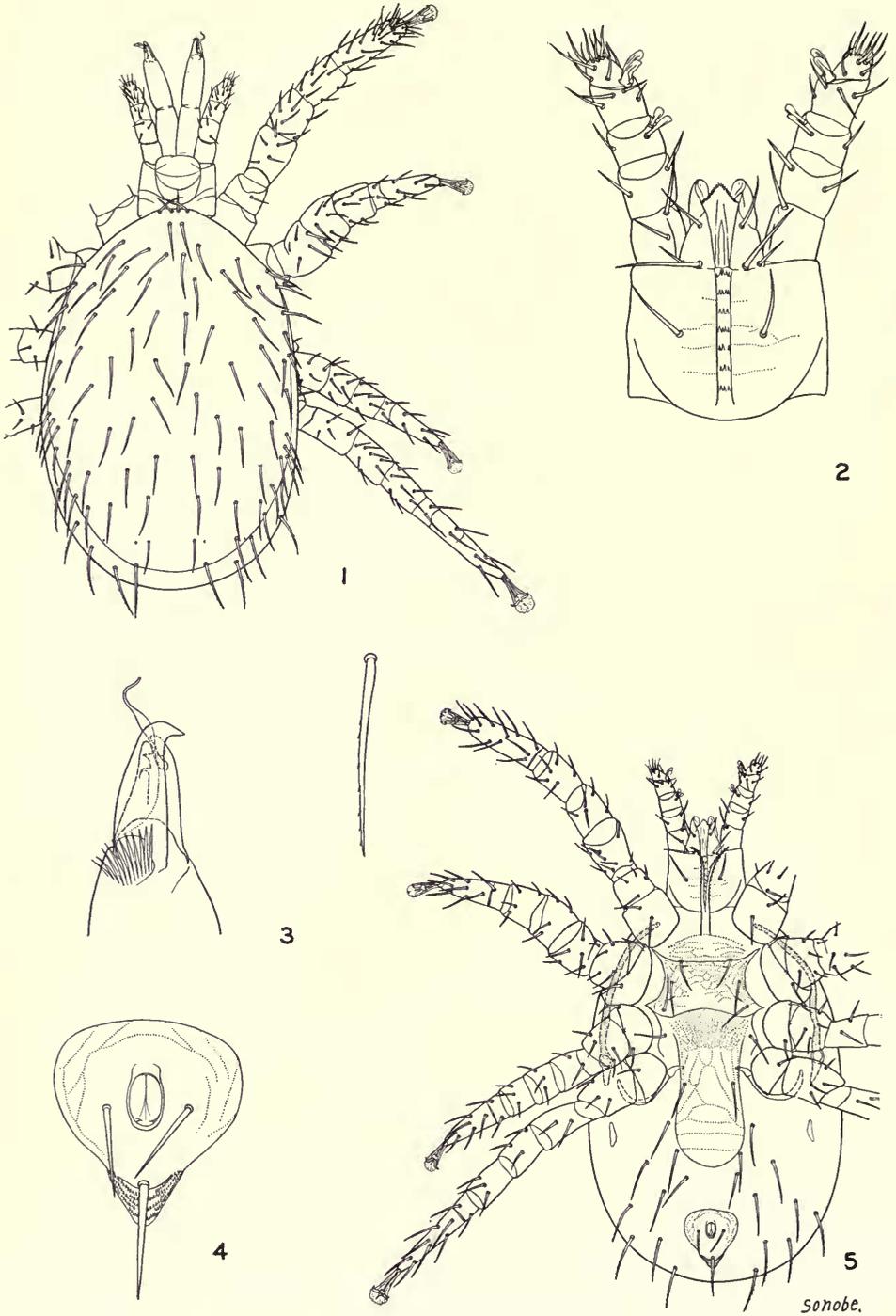
Haemolaelaps glasgowi (Ewing), female, from *Peromyscus nudipes*, Rancho Mojica, and *Reithrodontomys sumichrasti*, Cerro Punta. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



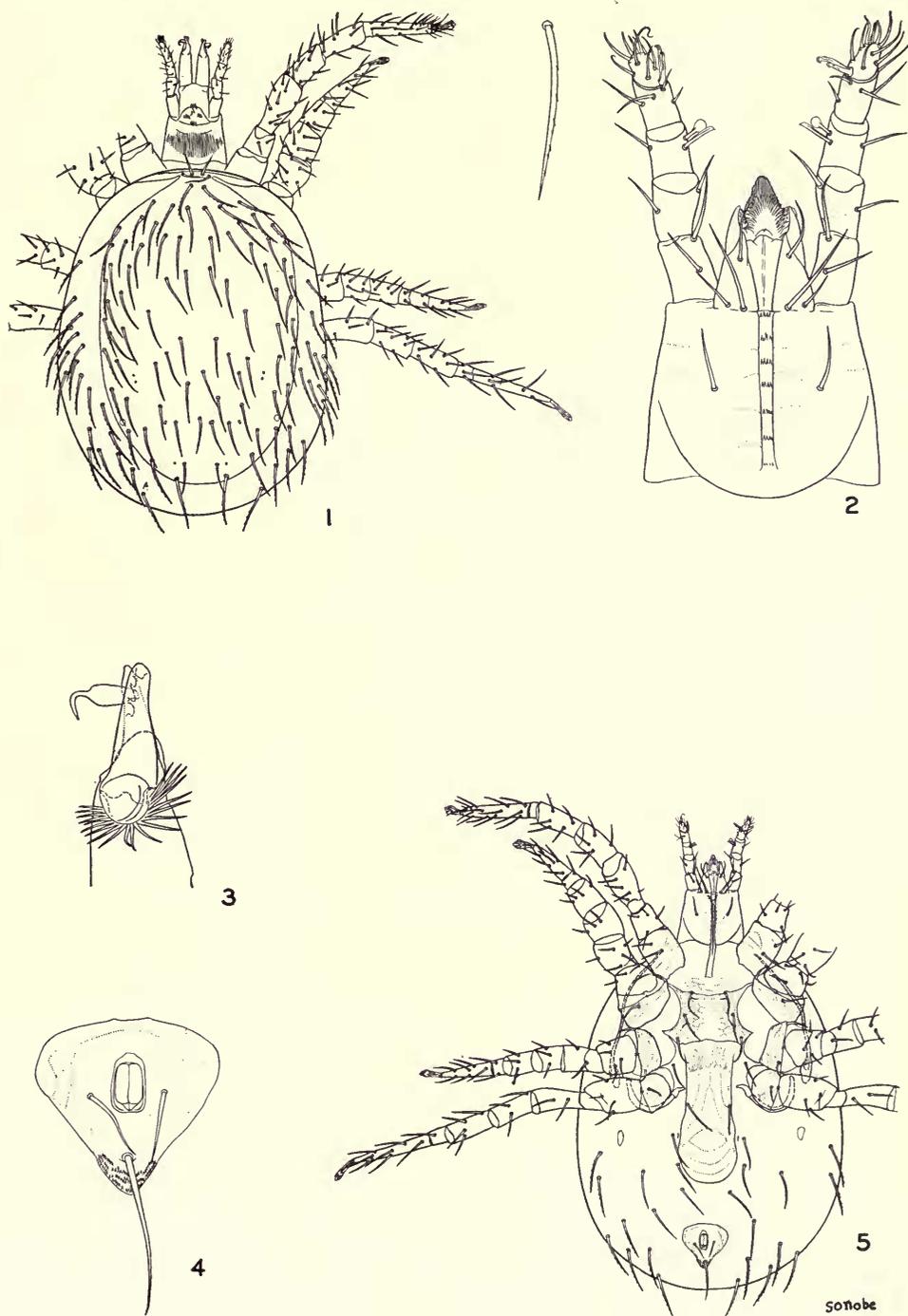
Haemolaelaps glasgowi (Ewing), female, from *Nyctomys sumichrasti*, Cerro Azul.
 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



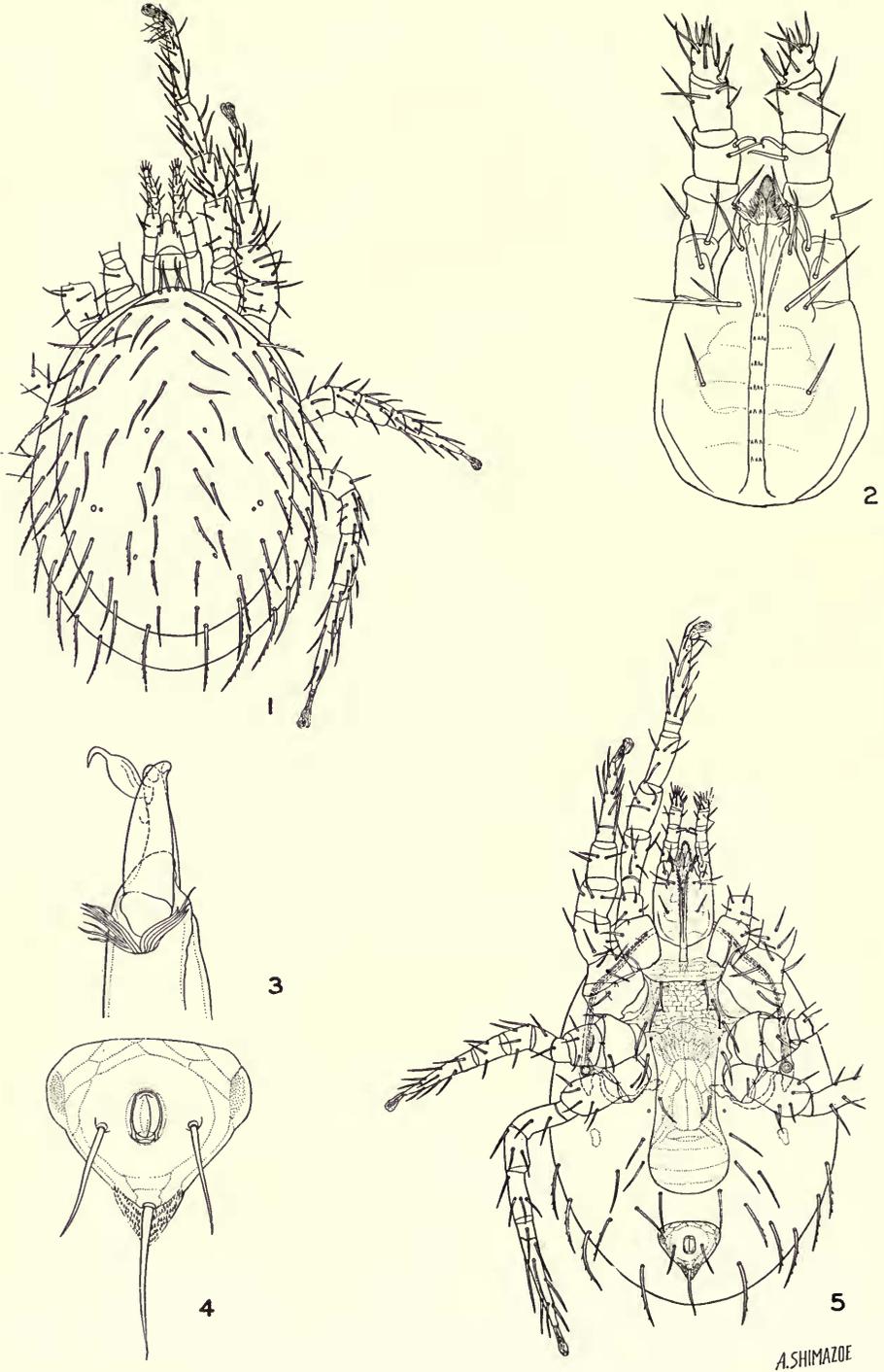
Haemolaelaps glasgowi (Ewing), female, from *Liomys adpersus*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



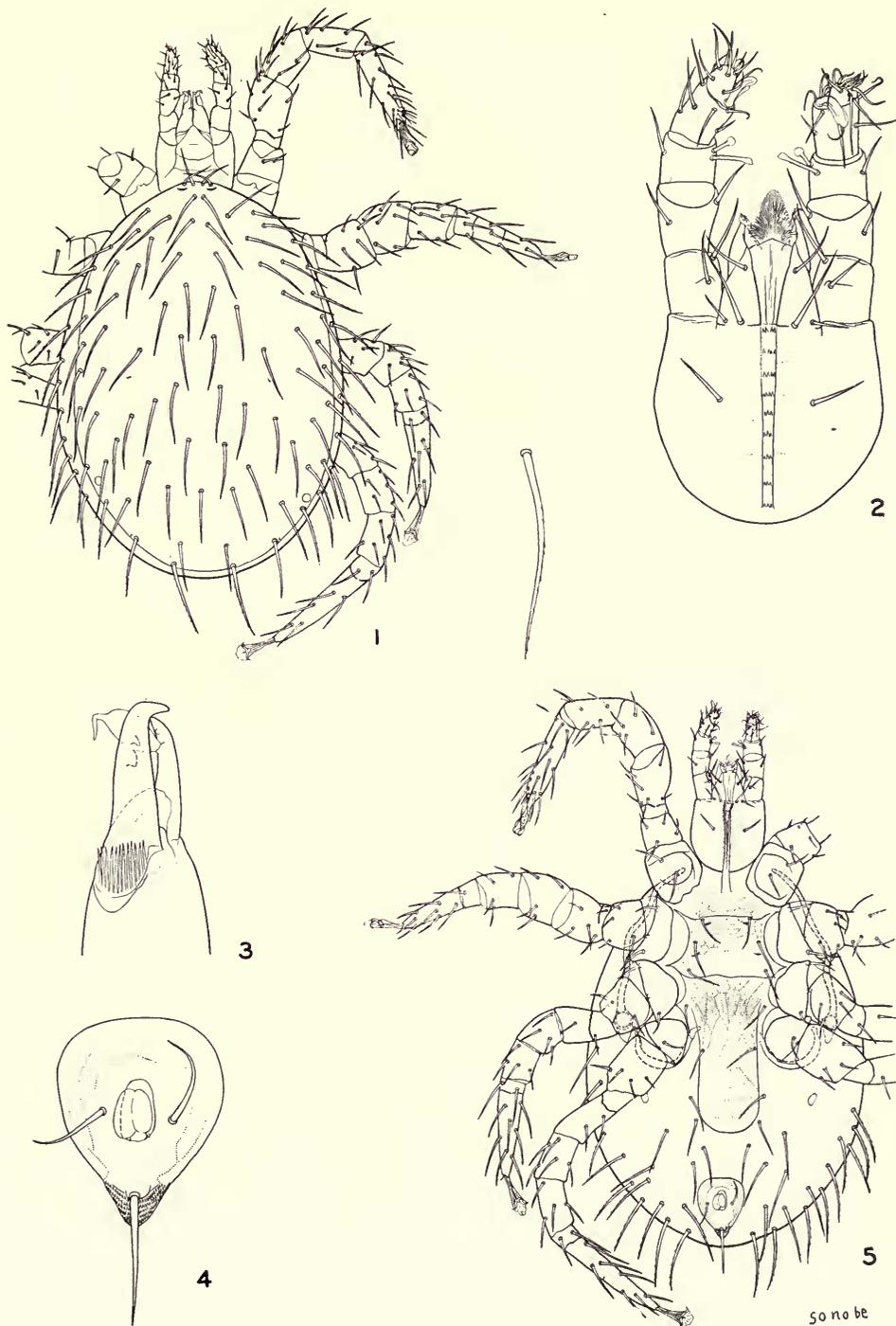
Haemolaelaps glasgowi (Ewing), female, from *Sigmodon hispidus*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



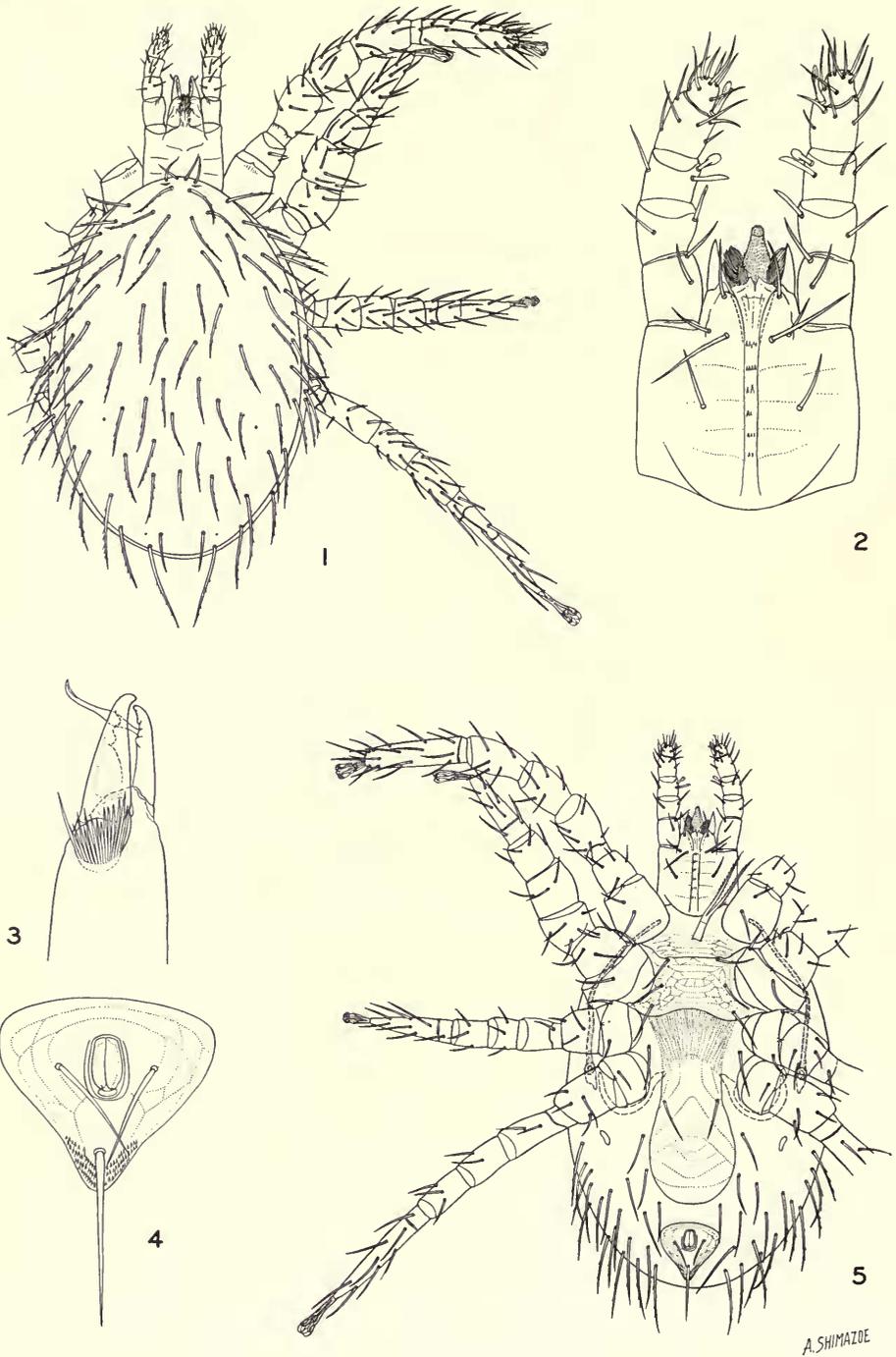
Haemolaelaps glasgowi (Ewing), female, from *Oryzomys fulvescens*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



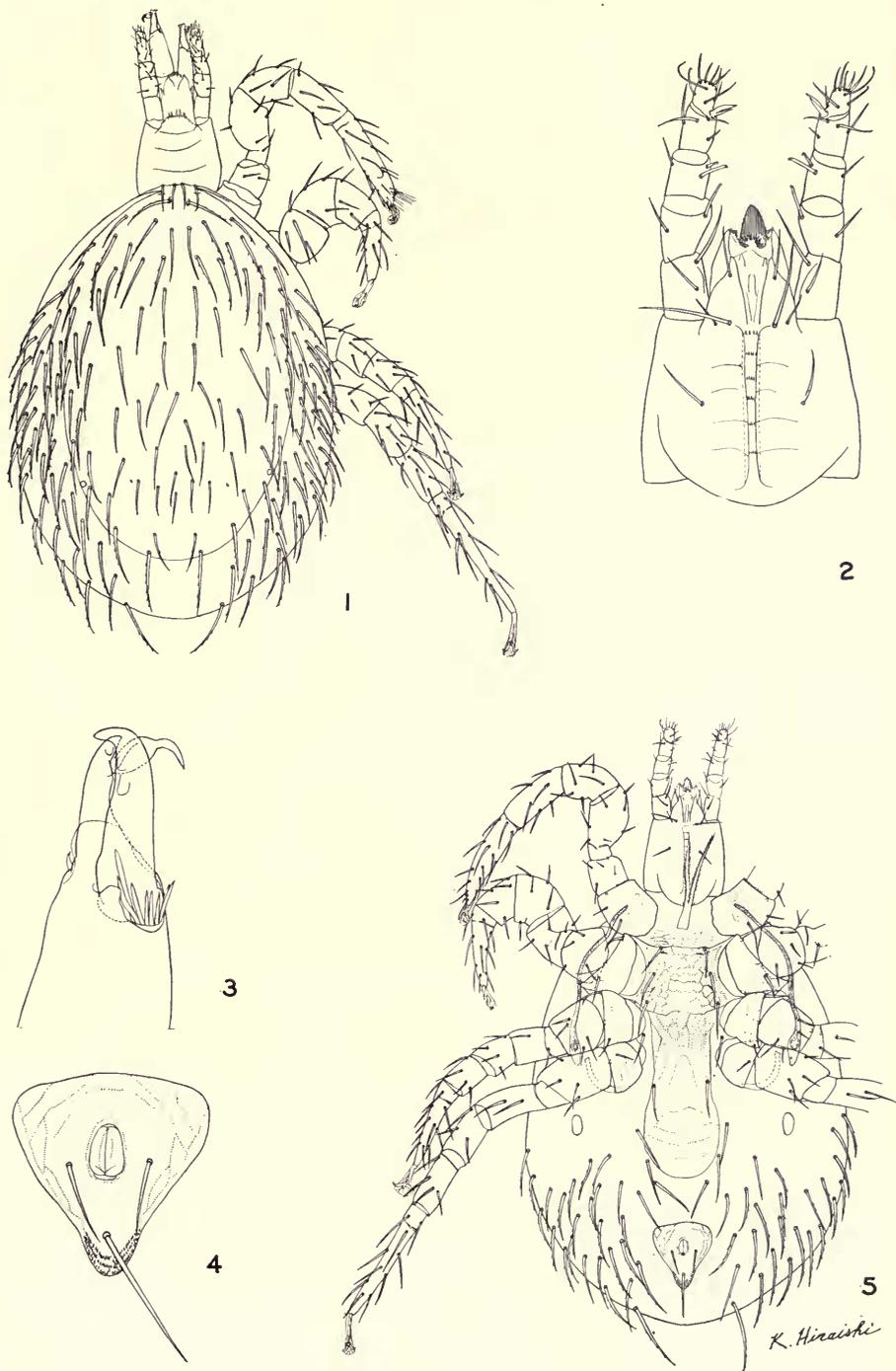
Haemolaelaps glasgowi (Ewing), female, from *Hoplomys gymnurus*, Cerro Azul. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



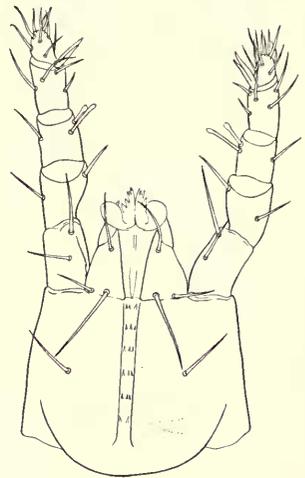
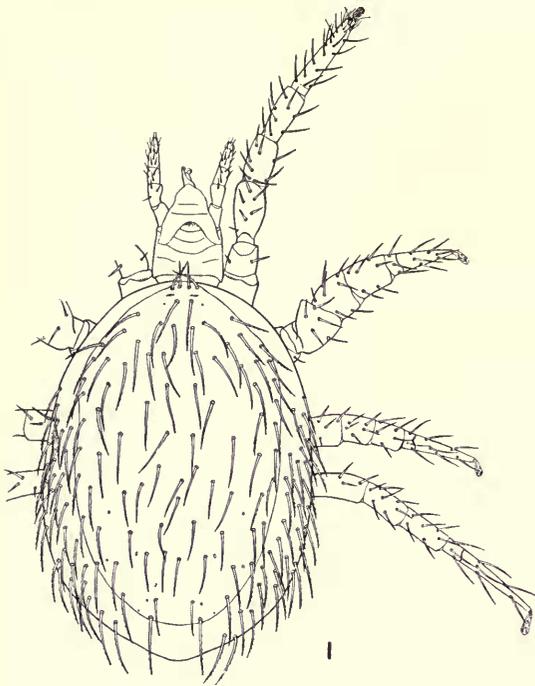
Haemolaelaps glasgowi (Ewing), female, from *Philander opossum*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



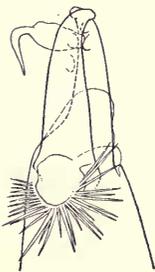
Haemolaelaps glasgowi (Ewing), female, from *Sciurus granatensis*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



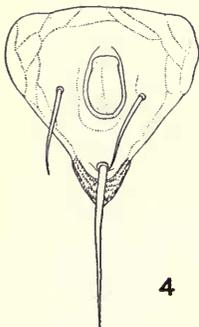
Haemolaelaps glasgowi (Ewing), female, from *Oryzomys capito*, Cerro Azul. 1, dorsal plate. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



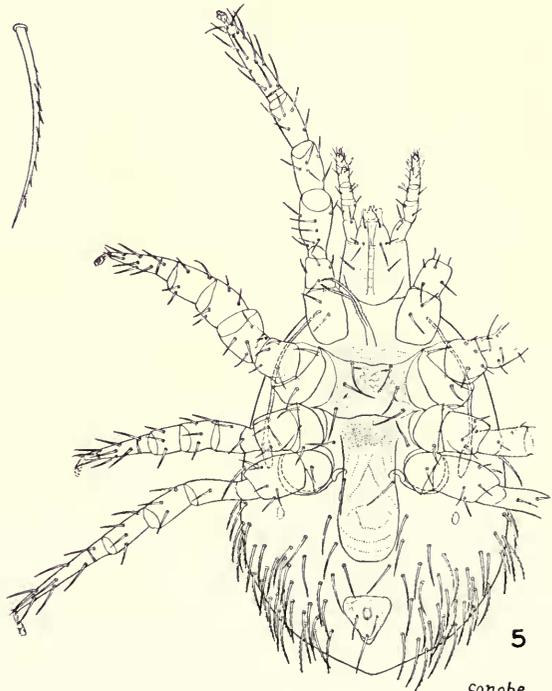
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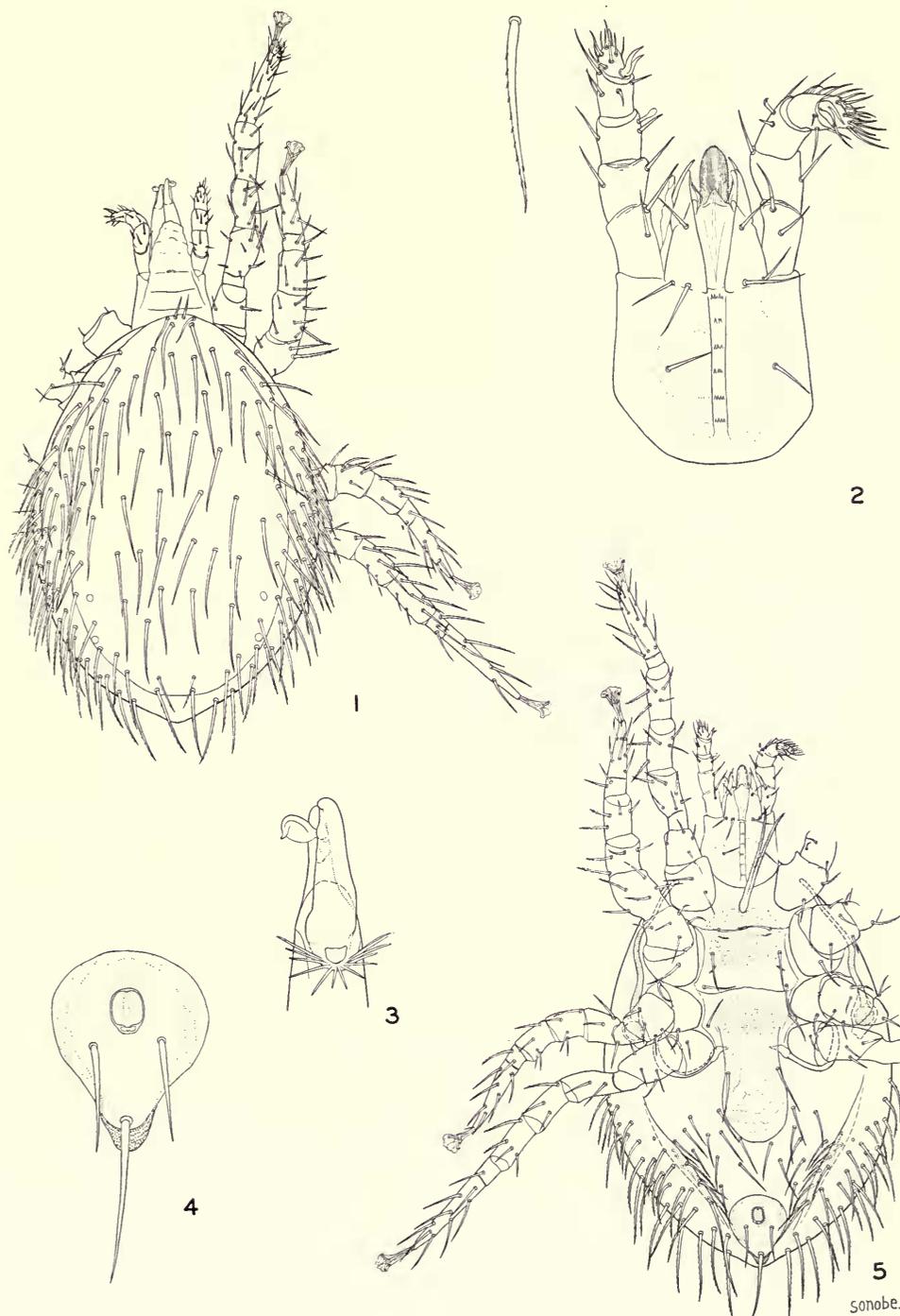
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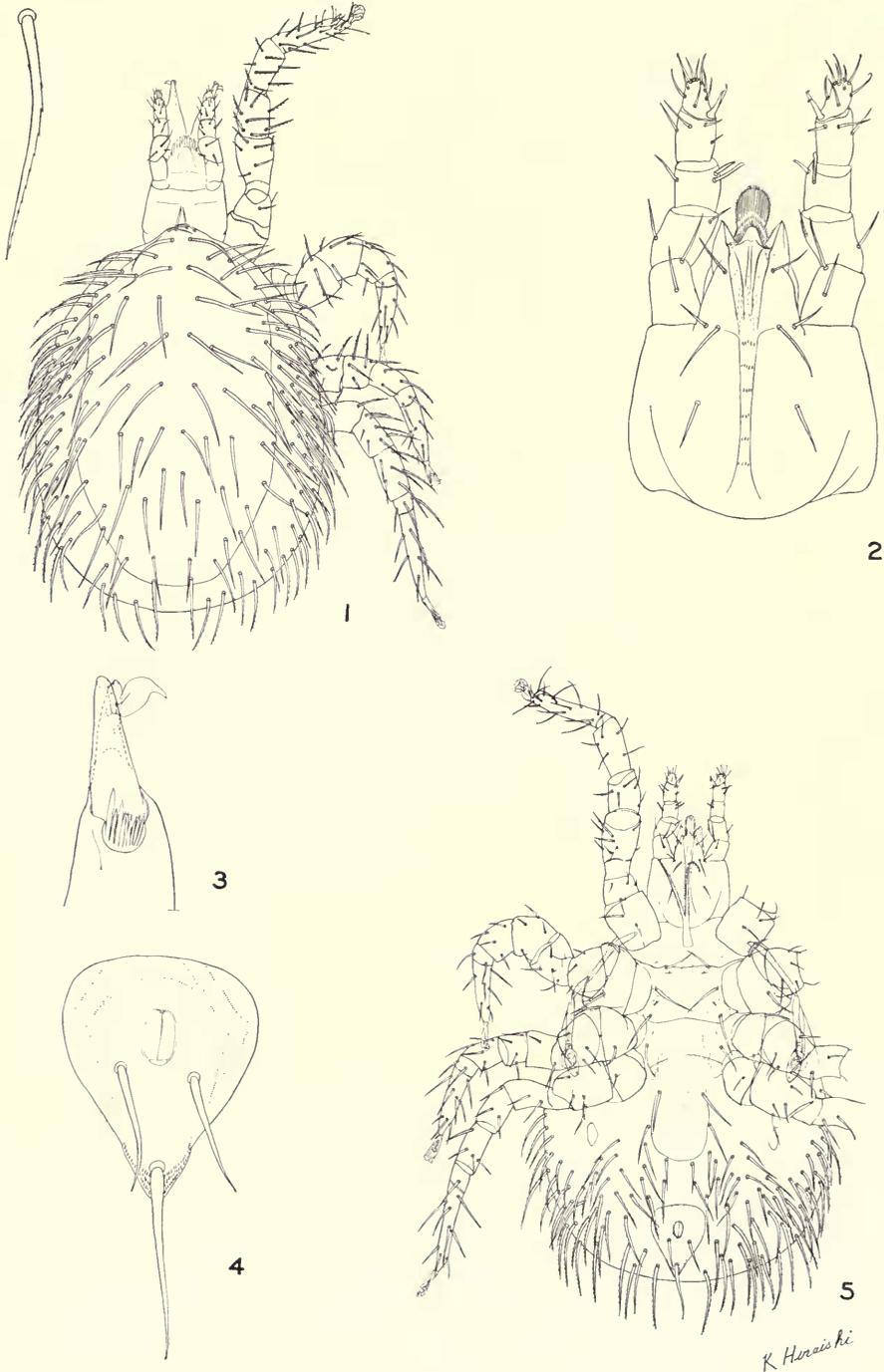
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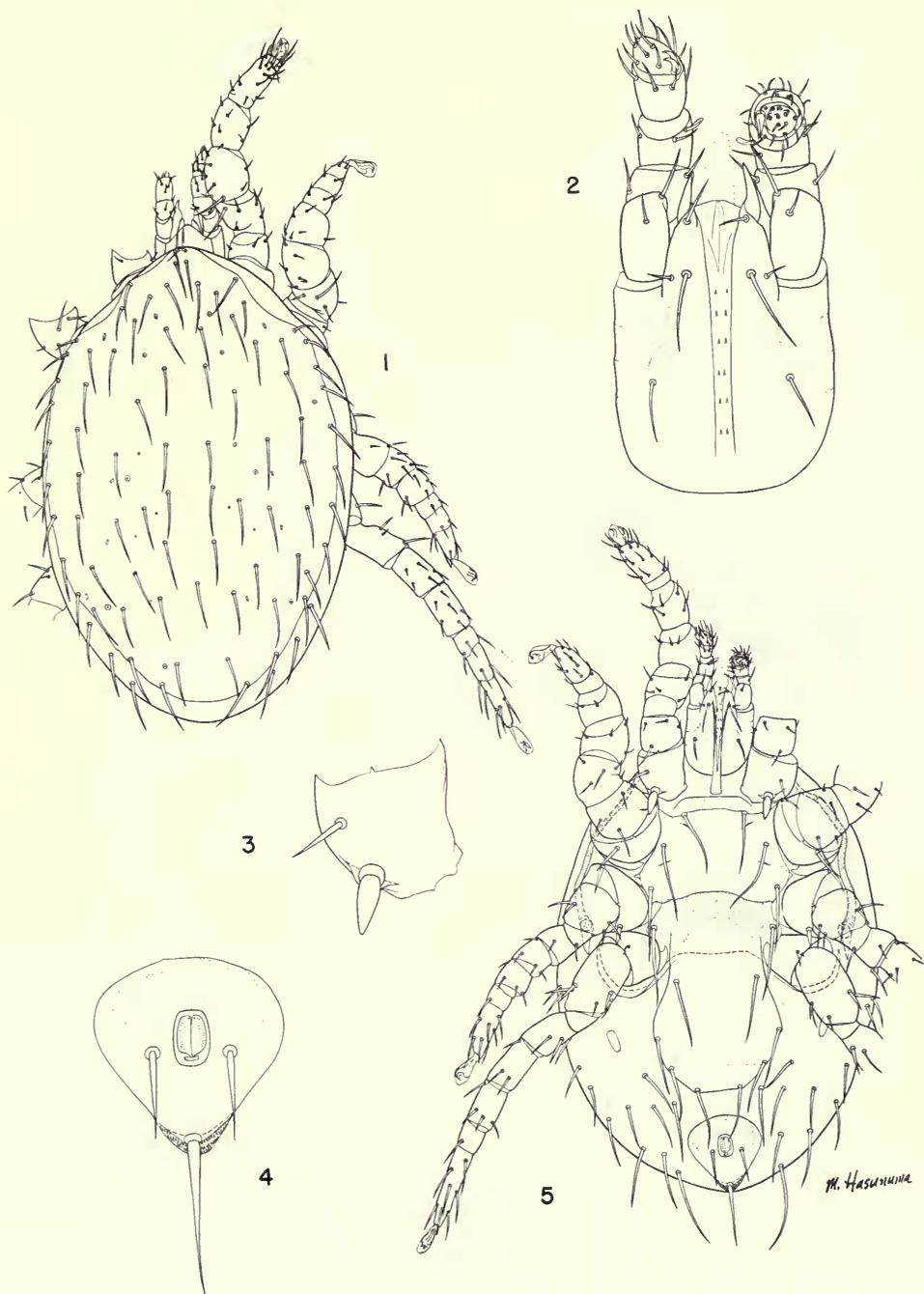
Haemolaelaps glasgowi (Ewing), female, from *Nectomys alfar*, Cerro Azul. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



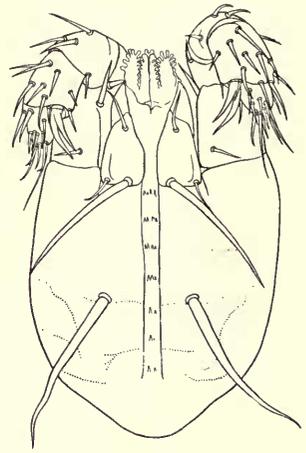
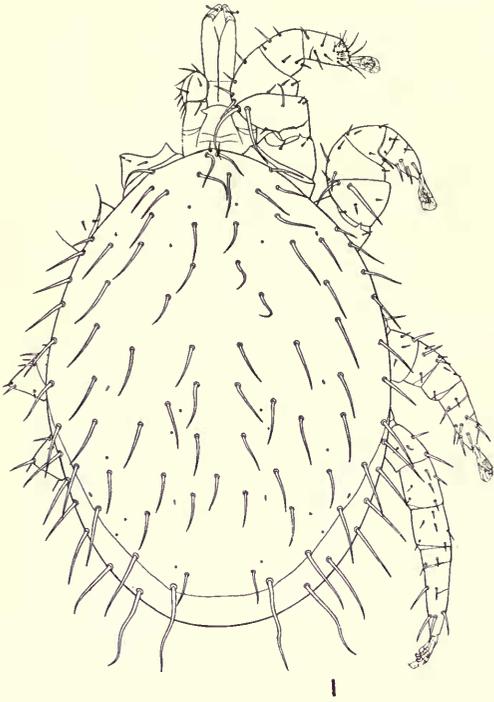
Haemolaelaps glasgowi (Ewing), female, from *Metachirus nudicaudatus*, Canal Zone.
 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



Haemolaelaps glasgowi (Ewing), female, from *Metachirus nudicaudatus*, Cerro Azul. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



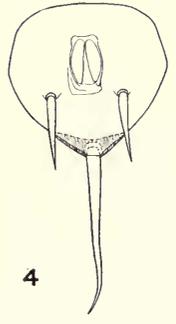
Laelaps castroi Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, coxa I. 4, anal plate. 5, ventral view.



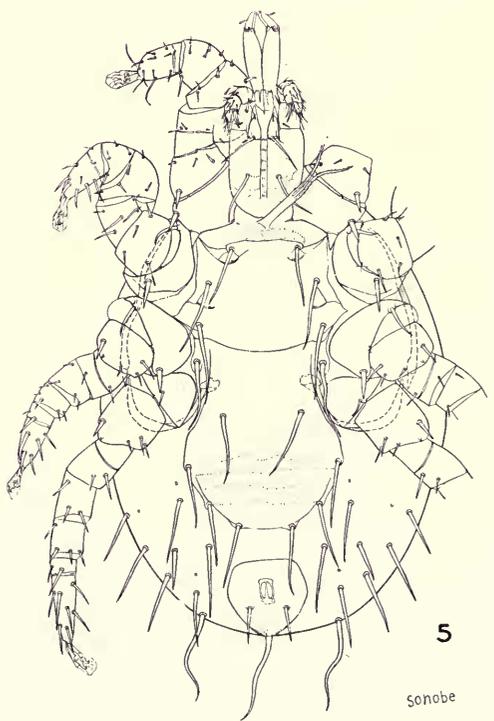
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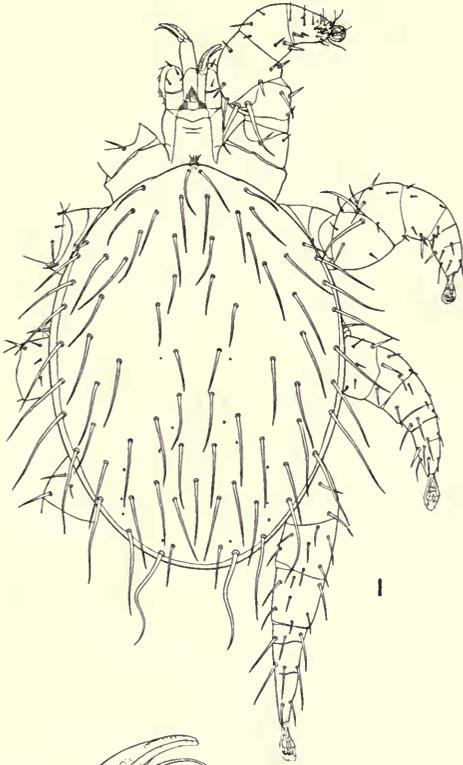
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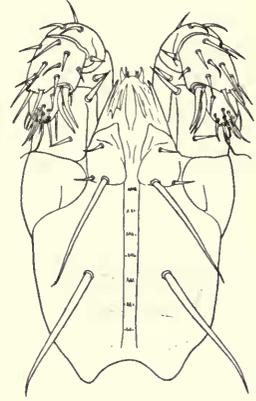
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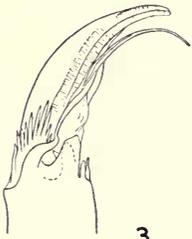
Laelaps dearmasi Furman and Tipton, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



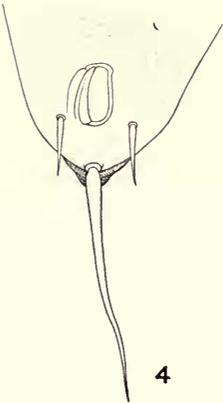
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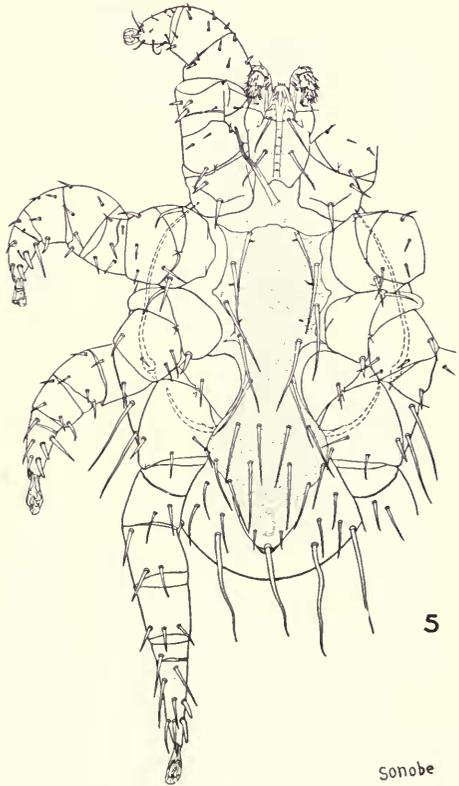
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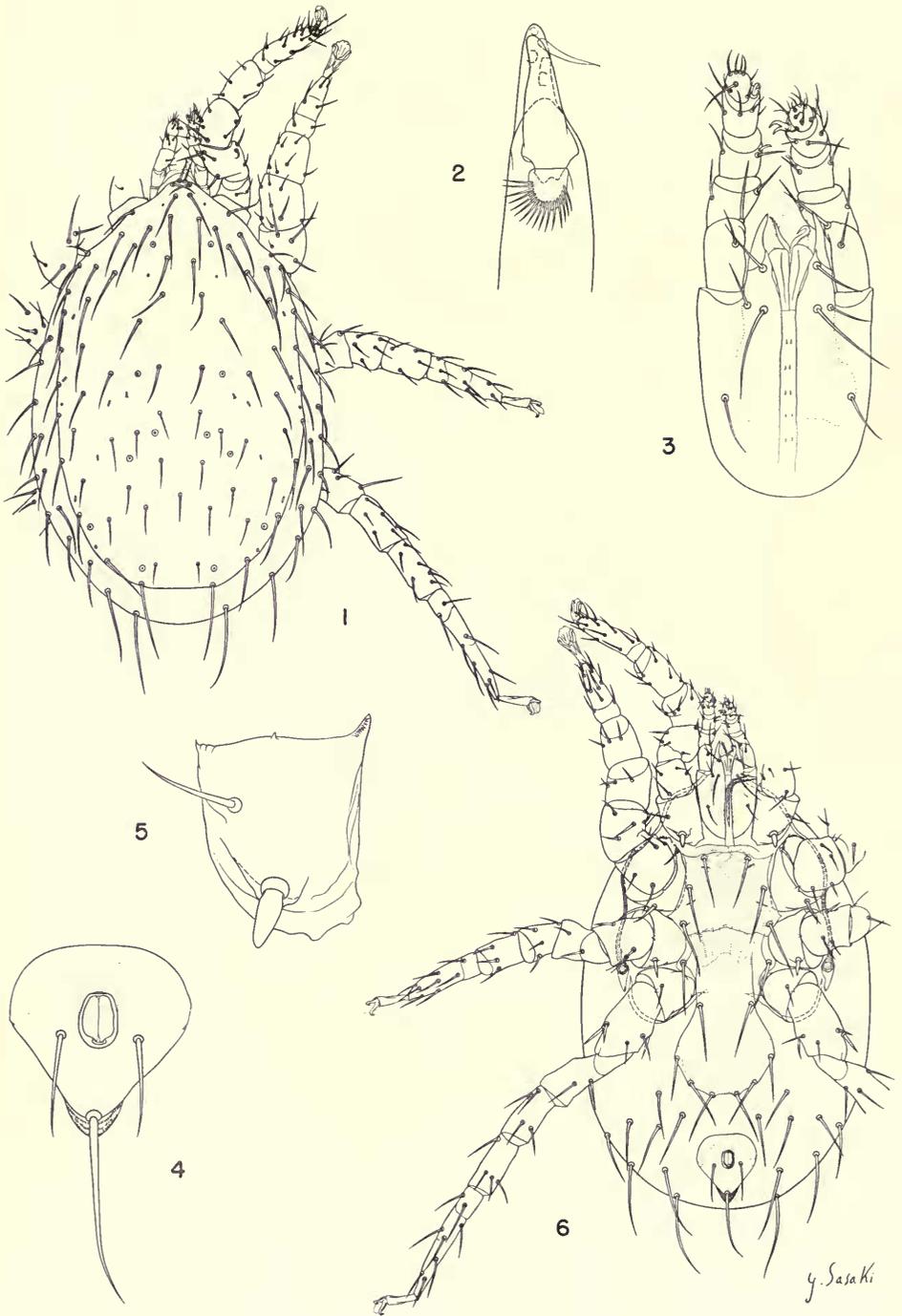
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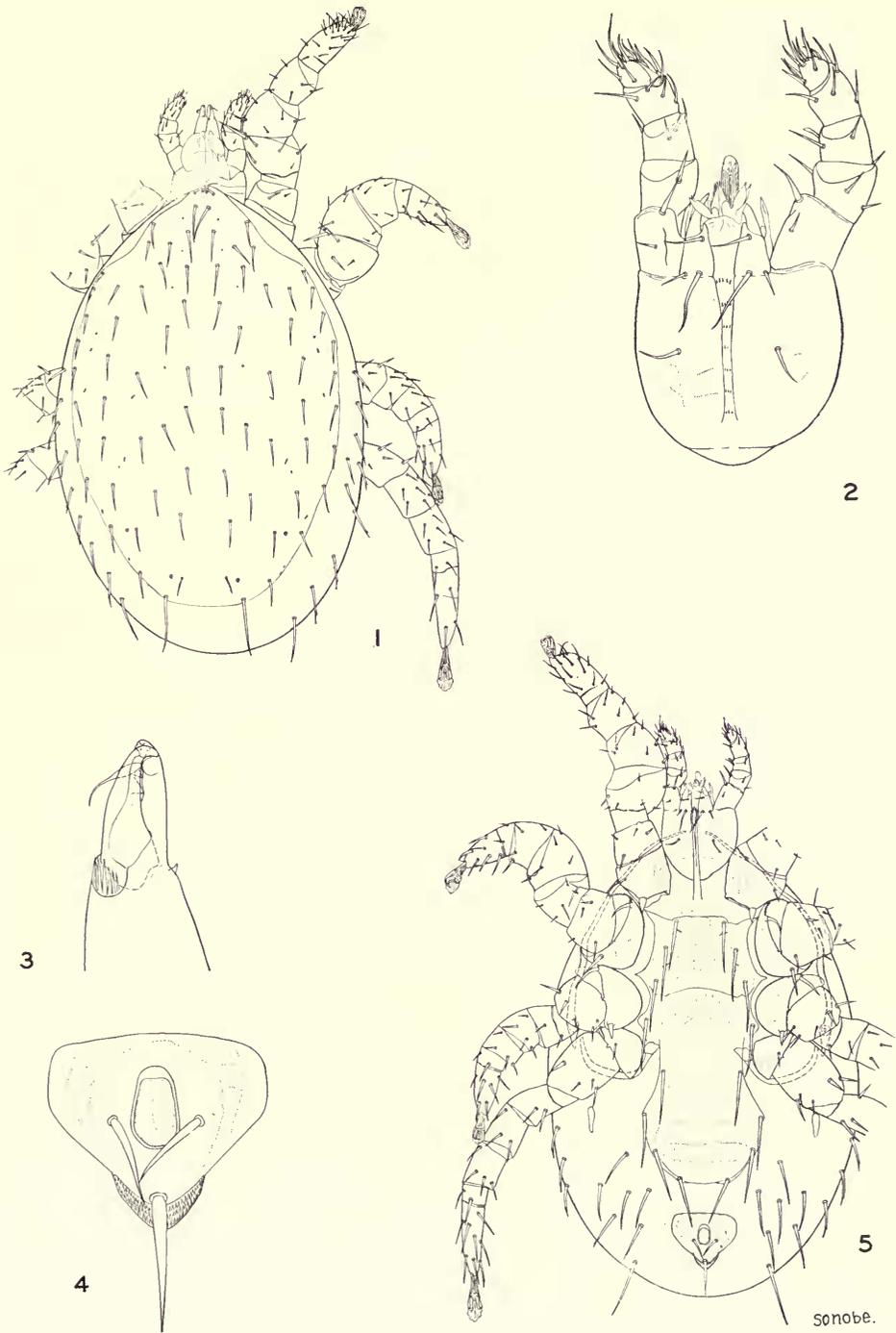
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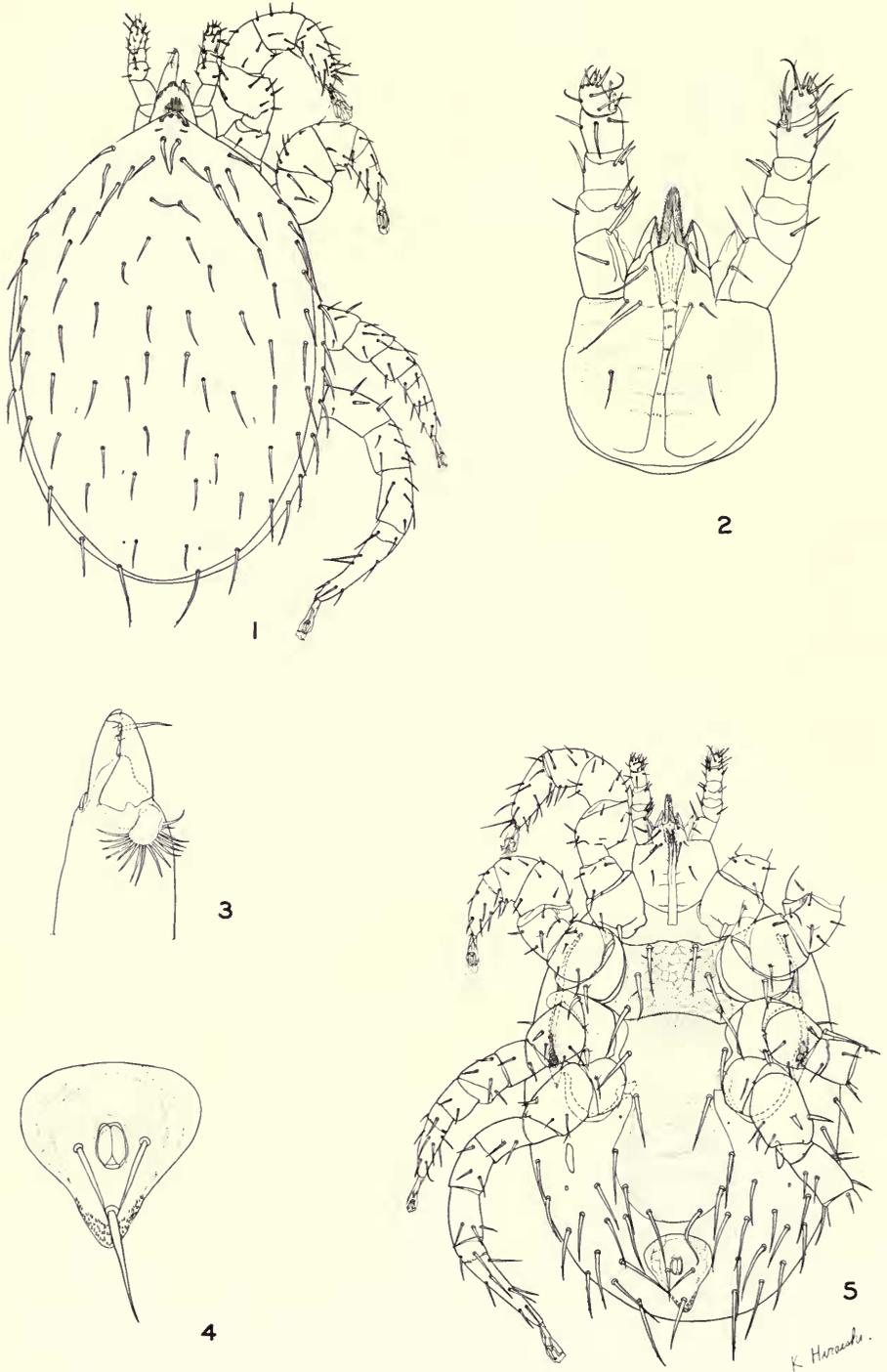
Laelaps dearmasi Furman and Tipton, male. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



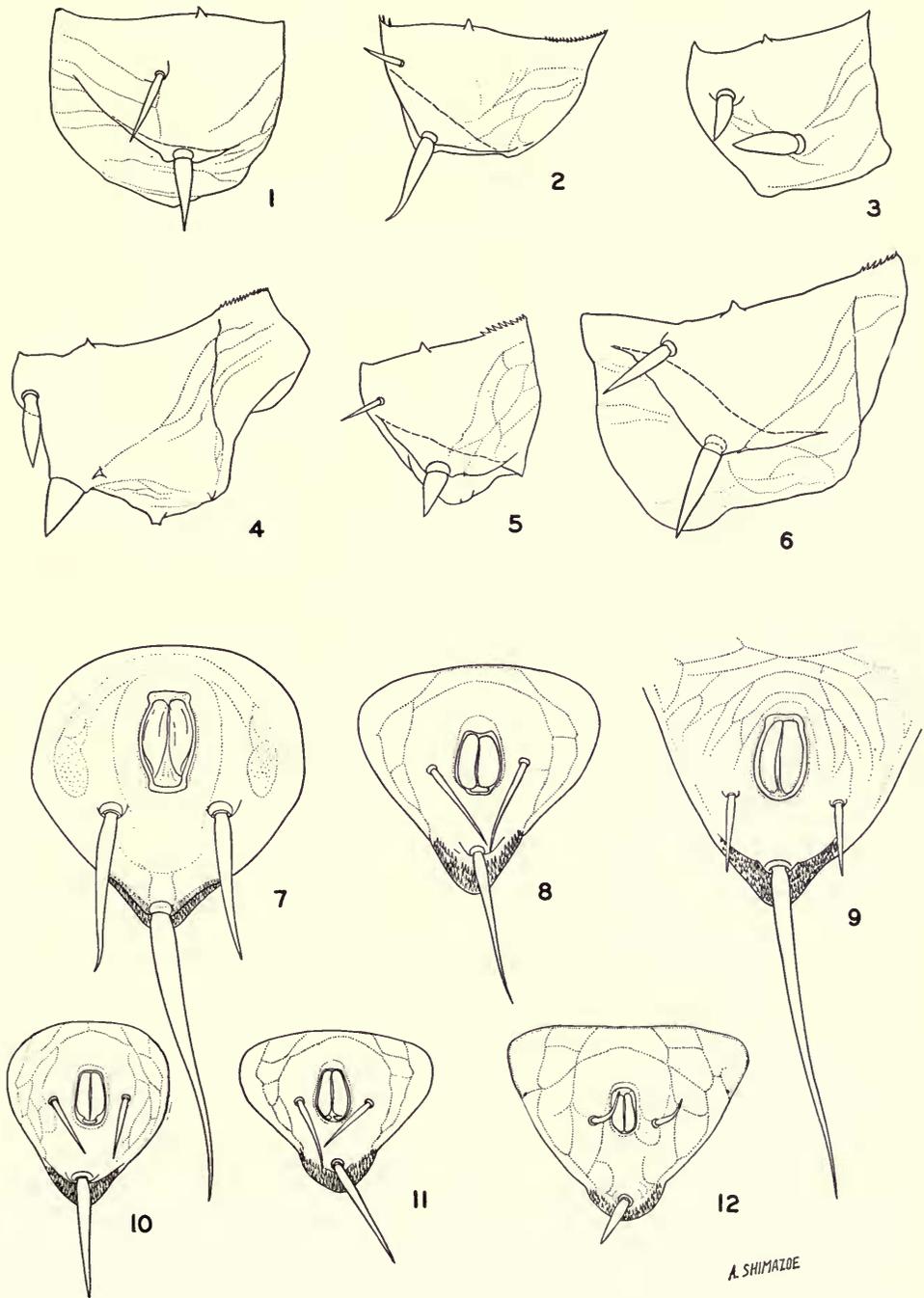
Laelaps paulistanensis Fonseca, female. 1, dorsal view. 2, chela. 3, gnathosoma. 4, anal plate. 5, coxa I. 6, ventral view.



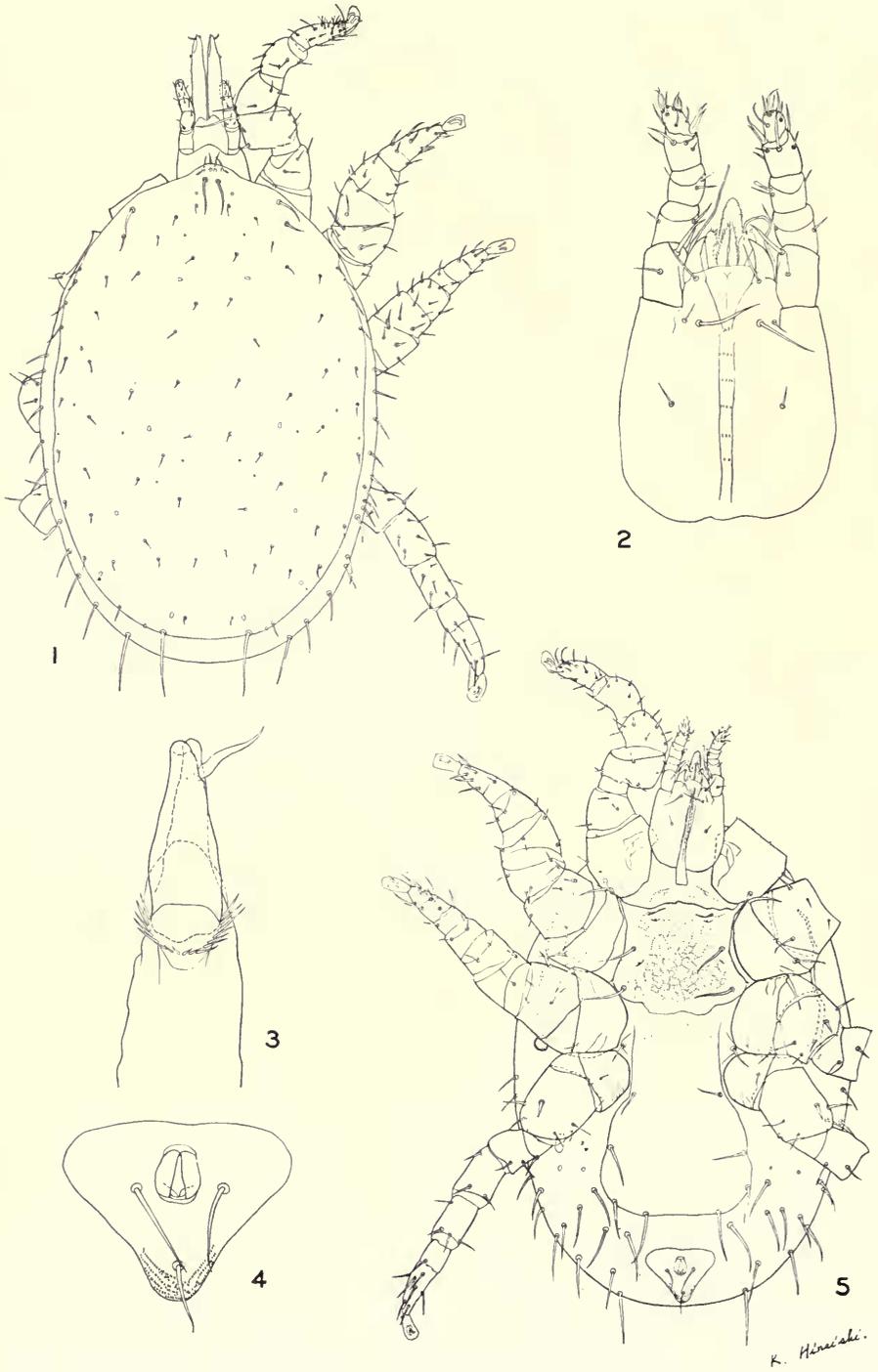
Laelaps pilifer Tipton, new species, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



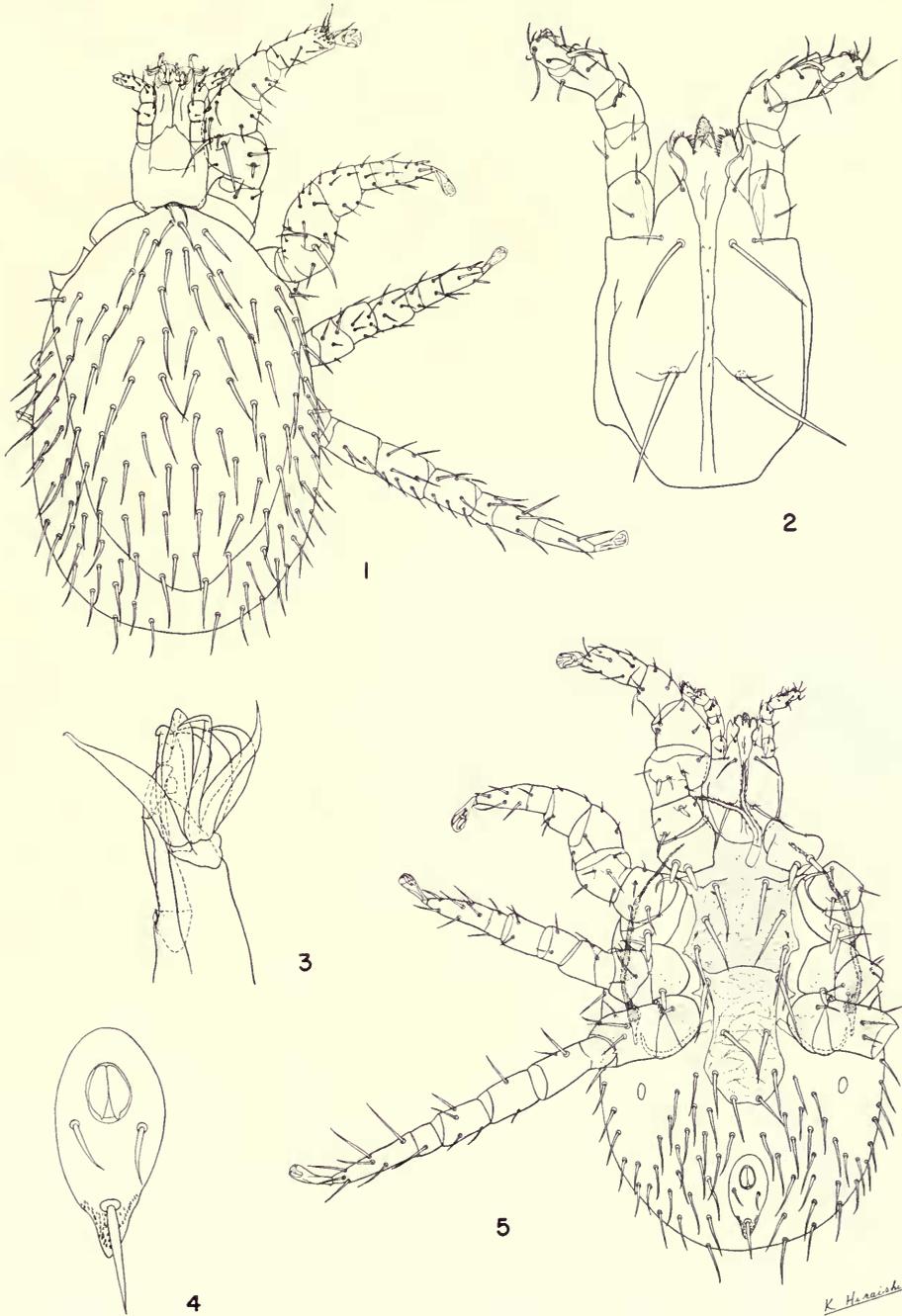
Laelaps thori Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



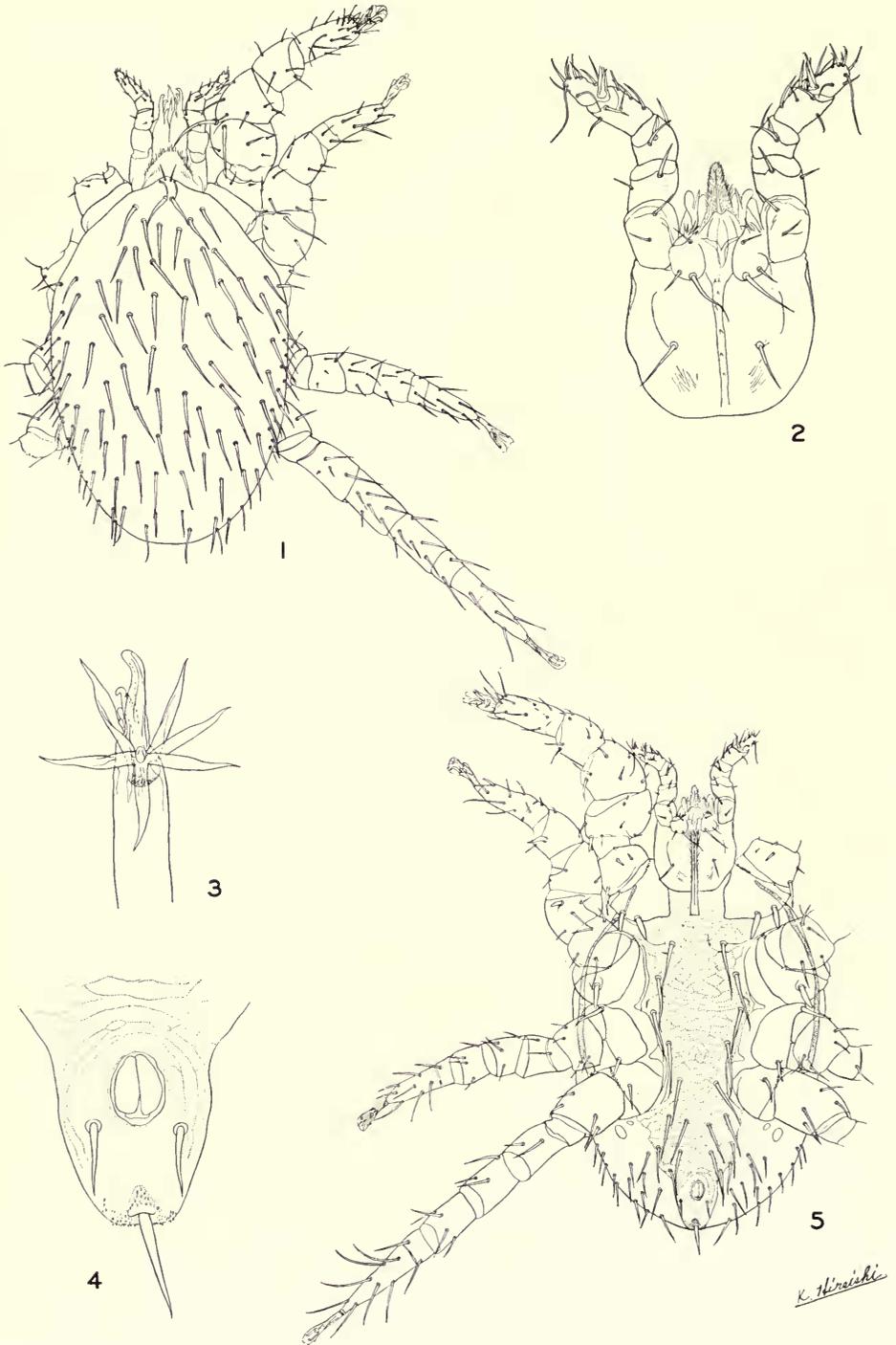
Coxa I and anal plate. *Laelaps dearmasi* Furman and Tipton, female (figs. 4, 7), male (figs. 6, 9). *L. pilifer* Tipton, new species, female (figs. 5, 11). *L. thori* Fonseca, female (figs. 1, 8). *Laelaps* sp., female (figs. 2, 10). *Tur anomalus* Tipton, new species, female (figs. 3, 12).



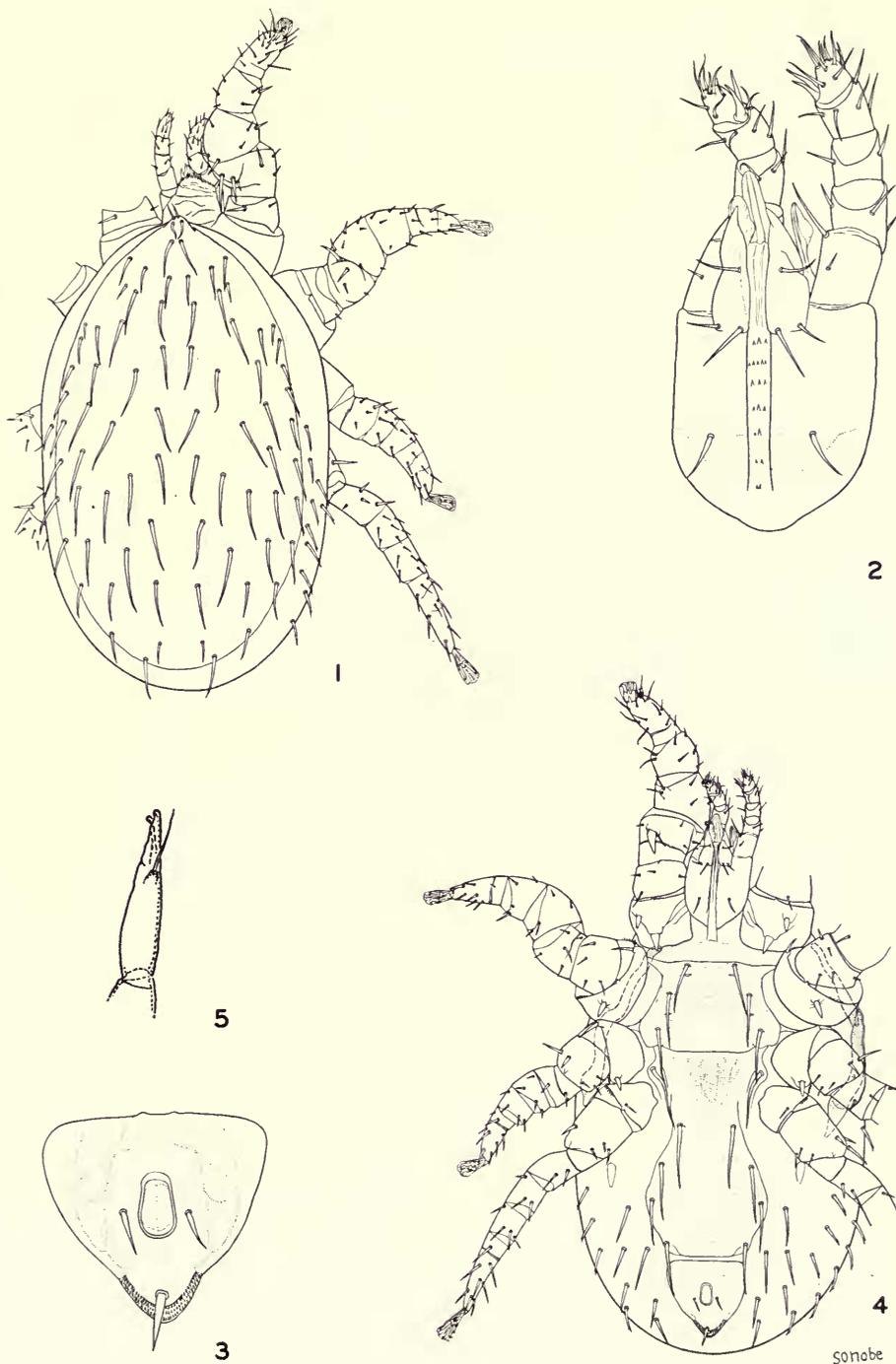
Mysolaelaps parvispinosus Fonseca, female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



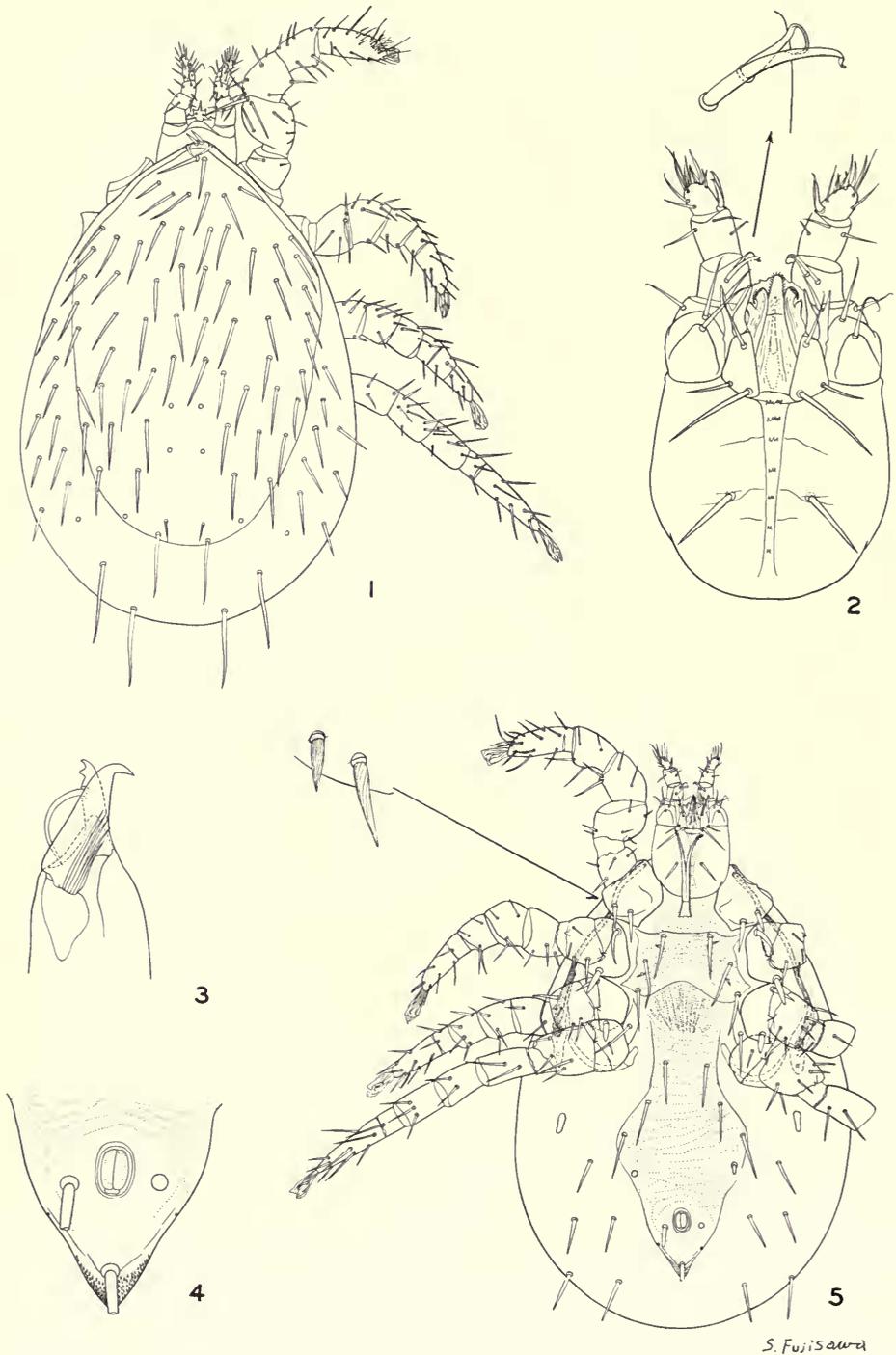
Steptolaelaps heteromys (Fox), female. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



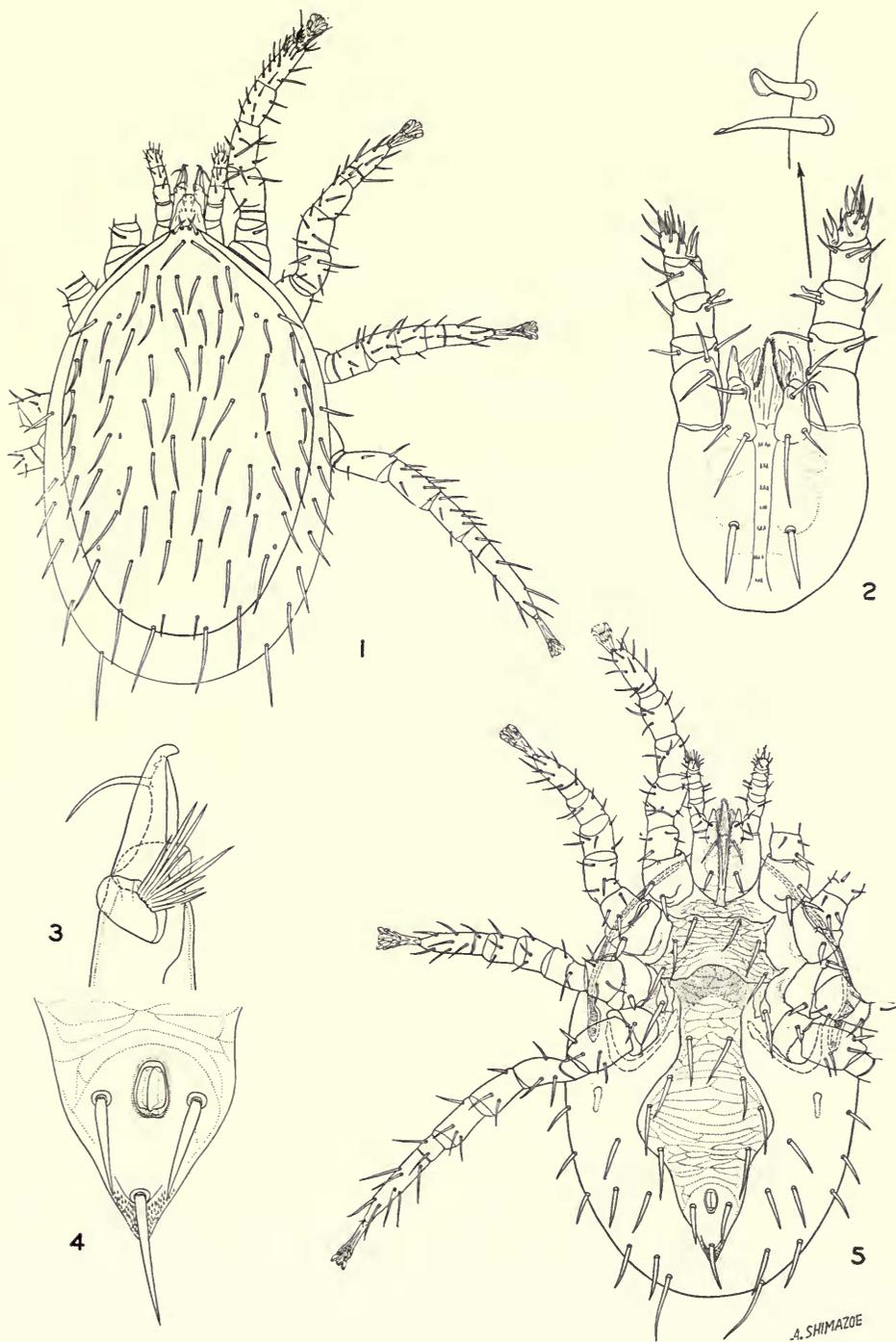
Steptolaelaps heteromys (Fox), male. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



Tur anomalus Tipton, new species, female. 1, dorsal view. 2, gnathosoma. 3, anal plate. 4, ventral view. 5, chela (drawn from photograph).



Tur uniscutatus (Turk), female, from *Proechimys semispinosus*, Canal Zone. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.



Tur uniscutatus (Turk), female, from *Hoplomys gymnurus*, Cerro Azul. 1, dorsal view. 2, gnathosoma. 3, chela. 4, anal plate. 5, ventral view.